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Engineering News-Record

Devoted to Civil Engineering and Contracting
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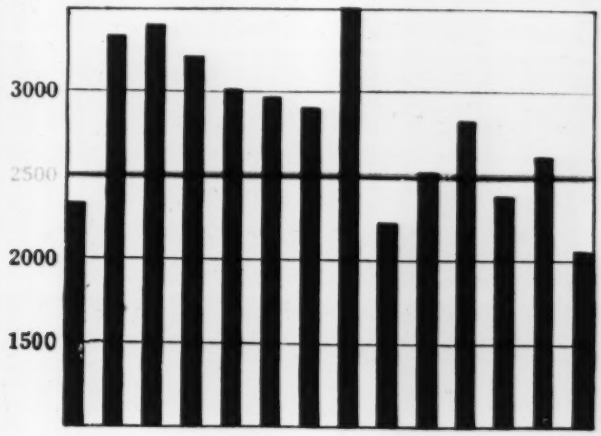
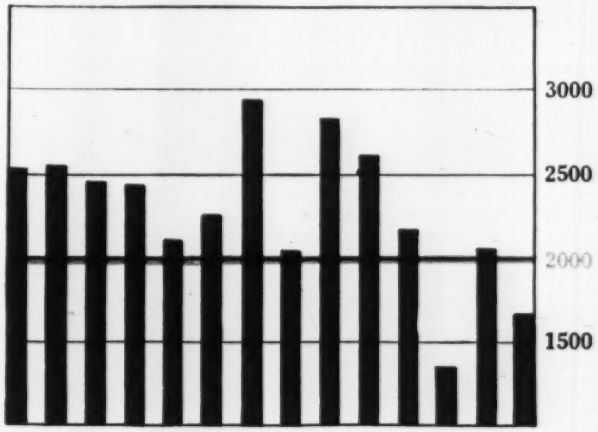
Designing Concrete Mixes for Desired Strengths

The batches of concrete represented by the vertical lines in the diagrams are of different mixtures, varied according to atmospheric and aggregate conditions, but each was designed for the 28-day strength of its class, viz: 2500, 2000 or 1500 lbs. Note how few fall below the desired strength. This was consistently done on the Nipigon power project of the Hydroelectric Power Commission of Ontario.

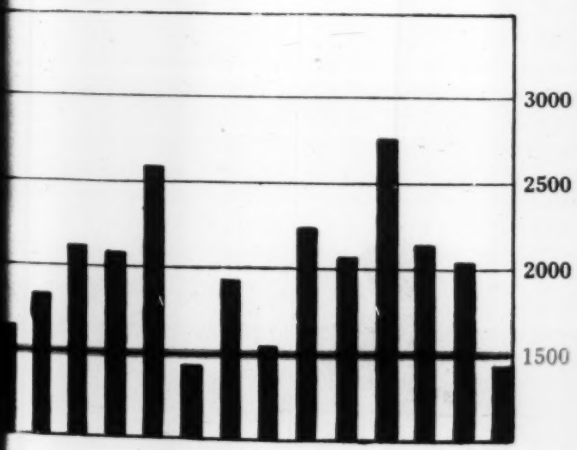
R. B. Young and T. V. McCarthy tell about it in this issue.



2500 lb. Concrete



2000 lb. Concrete



1500 lb. Concrete

Also In This Issue:

New Method of Testing Turbine Efficiency
By Norman R. Gibson

California's Highways Investigated by Federal Roads Bureau

Water-Waste Prevention and Results
By W. C. Lounsbury and A. W. Fowler

Sewage Treatment Testing Station at Grand Rapids, Mich.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 86 — NEW YORK, THURSDAY, MARCH 17, 1921 — Number 11

Barge Canal Back to State Control

BY VIRTUE of the act of Congress signed the last of February the federal adventure on the New York State Barge Canal is to be brought to an end. The traffic and operation organization will be dispersed and the new and old floating equipment, which had only just begun to be used with any approach to efficiency, will be sold. New York once more gets back actually the control which it has always nominally exercised, and what the waterway advocates contend is the only fair test—that is, a unified control—may at last commence. The federal operation had its defects, but at least it recognized that the canal problem is now one of traffic. The state, if it appreciated that, certainly has not got results. The new state administration now has the whole canal in its hands. Will it set to work to develop an operating organization which will see that there is furnished a responsible, continuous and safe service, and at the same time make some effort to get people to use that service? Or will it content itself with offering a satisfactory waterway and persist in wondering why people do not use it? Will it continue the federal policy of a government-owned freight service sufficiently large to test the possibilities of the canal, or will it revert to its own original theory of the canal as a free waterway to be developed by competitive service?

Railway Track Labor Problem

AN ARRAIGNMENT of the railways, and indirectly of the engineering departments, for neglecting improvement in unsatisfactory track labor conditions is contained in the report of the committee on economics of railway labor, presented at the annual meeting of the American Railway Engineering Association. Neither efficiency nor economy can result from a high labor turnover, since so much of railway track work is in reality skilled work, but it appears from the committee's report that the railways have done very little toward stabilizing conditions of maintenance-of-way labor. There are manifest difficulties but certainly the railways have been outdistanced by public utility and industrial companies in respect to employment and housing conditions. One of the principal evils—and the remedy, it must be conceded, is not easy to find—is the failure to distribute track work throughout the year, resulting in increasing forces each spring and reducing them before winter. With steadier employment, better housing and boarding accommodations would naturally follow. It is encouraging to note the frankness of the committee report in recognizing the evils. It is becoming generally recognized that a movement to improve these conditions would be to the direct interest of the railroad as well as of the laborer. In carrying out a general program a serious difficulty is the radical difference in local conditions and in practices on individual railroads. Nevertheless, it would seem to be a proper function of the American Railway Engineering Association to conduct a broad investigation of track-labor conditions with a view to formulating recommendations to the American Railway Association for a campaign of betterment.

Sewage Removal Outruns Disposal

SEWAGE removal has been so far perfected and so generally applied in our cities and towns as compared with carefully planned and executed means of final disposal that it is no exaggeration to say that sewage removal far outruns disposal. Why should this be so? A ready and short answer is, "out of sight out of mind," but this is incomplete. The fundamental fact is that the removal of sewage from buildings is more essential to comfort and far more vital to health than its disposal. Accordingly, we have perfected our house plumbing, our lateral and main sewers, while, comparatively speaking, we have given little attention to sewage disposal. Those who complain of the little thought and effort given to sewage disposal, compared with water-supply, should bear in mind (1) that public water supplies are of prime importance for convenience of the citizens, for fire protection and for health; (2) that adequate means of sewage collection and removal, first from our houses and next from our streets and cities, have been provided; and (3) that the disposal of sewage, once it is removed from inhabited districts, has no such vital relation to public health as has water-supply.

Engineer Corps Vacancies

SENIOR students in engineering colleges, as well as graduates under 30 years of age, will have an opportunity next month of becoming officers in the Corps of Engineers, U. S. Army, hitherto very largely restricted to West Point graduates. There are 118 vacancies to fill in the grade of second lieutenant and the examination, as announced in last week's issue, is set for April 25. The pay of a second lieutenant, $2,120 including bonus, is more than most graduates will receive in private employment immediately after leaving college, but to the best men, of course, outside opportunities for financial advancement, after half a dozen years of experience, are more attractive than are those of the Army. Nevertheless to the young man who likes the Army life the chance of a commission in the Corps of Engineers should not be lightly passed by. He will, in all probability, have a varied experience, including service with troops, instruction and inspection of organized reserves, and construction work connected with fortifications and the improvement of rivers and harbors. His changes of station are apt to be frequent and he will be able to visit different parts of the country, and, if he has eyes to see, broaden his outlook thereby. Some men are temperamentally and constitutionally unfitted for Army service. Others take to it naturally. For the latter service in the Corps of Engineers offers permanent and honorable employment.

Predicting Concrete Strengths

ALL the theorizing and experimenting that is being done on concrete is directed toward the bettering of the material in practice, but it is sometimes difficult to see where the practical applicability lies. For a while this was especially true of the studies that started some years ago with the papers by Professor Abrams and Captain Edwards. It was evident that the investigators were opening up new trails toward a better concrete and, what is more important, a uniform concrete, but for a time these trails seemed pretty well cluttered up with the underbrush of testing data. Practical progress is now beginning to be made and nowhere is it serving a more useful purpose than in the work of the Ontario Hydro-electric Power Commission, where R. B. Young has been applying the new theories to concrete actually placed in large quantities. The article on another page, which reports the latest results of the work, shows that a remarkable conformity of prediction to results has been achieved. In the 2,500-lb. concrete class only one batch of concrete tested out of twenty-six fell below 200 lb. less than the strength desired and the average of the remaining ten deficient batches averaged only 95 lb. below; the grand average was 55 lb. above 2,500 lb. Better results were achieved with the leaner concretes; only two out of fourteen being below average in both cases. This is predicting strengths with consistent accuracy. The possibilities unfolded by these methods are many. They prove that better concrete than is usually produced can be attained when proper care and science are conjoined.

A Question of Fact

ATTEMPTING to account for unexpectedly good performance of engineering work is a necessary proceeding if full value is to be derived from the experience. In the case of the train wreck on the Georges Creek bridge, followed by repair of the bridge as described in our issue of Jan. 20, page 100, which revealed a surprising ability of the bridge to withstand severe battering, a study of what gave the bridge this quality was suggested in connection with that article. A. W. Buel's statement of the factors of resistance, on page 463 of the present issue, is illuminating, even though it may be considered incomplete. In fact, besides his discussion of rivet-hole reaming, the argument on short paneling contained in his article attracts attention because it is squarely opposed to the trend of modern opinion. The argument is too pointed to be disposed of by mere reference to the growing favor of long panels in modern steel bridge construction. The relative beam strengths of the members in long-panel simple-web trusses on the one hand, and short-panel subdivided-system trusses on the other, has to be considered in connection with the larger secondary stresses in the latter type. Some engineers hold that simple web systems, with longer panels, inherently give opportunity for more substantial and robust construction of the members than sub-paneled webs, and this is perhaps one of the motives for the increasing use of simple systems. But the logic of this contention is not obvious. And, what is more to the point it is by no means certain that the expected advantage is always obtained. The relative service resistance of simple and subdivided systems is in the last analysis not a theoretical question but a question of fact, to be determined by service experience.

Planning for the Unexpected

ENGINEERING PLANNING nearly always deals with uncertain conditions, and, though it gains in sureness by employing exact methods, its solutions cannot be exact. Hence the large part played by trained practical judgment in the art; and hence, also, the value of oft-renewed discussion of the objectives and guiding principles of engineering planning in any particular branch.

Recently, in such a discussion, which as usual brought forth both broad and narrow views, an engineer emphasized the point that it is the unexpected, rather than the normal and foreseeable event, that must govern engineering planning. In making this point he but stated an axiom of the art, one that has been recognized as such since the earliest days; yet his restatement of it came with striking force—perhaps simply because in our ever-growing sense of the exactness of technical procedure we incline to forget what a large borderland of future uncertainty surrounds the service of engineering works.

In ordinary cases many of the considerations derived from emergency requirements do not lie on the surface. It is instructive, therefore, to look at special fields in which the dominance of the unexpected, of the *possible* rather than the probable or average event, is particularly obvious.

In the fire protection of buildings, for example, all rules and practices are framed for the extreme unexpected happening; the stairs, doors and passages are proportioned for panic events, not for the movement of orderly assemblages. The whole value of the planning, in fact, is defined by its efficiency of functioning in emergencies, and any detail that fails in the crucial test of an emergency is worse than valueless. Railway and rapid-transit construction, and, indeed, most items of the engineering for communities, are equally clear demonstrations of the axiom in question: the chief criterion of excellence of a signal system is how it works when something goes wrong. The adequacy of a water supply, as to either quantity or purity, is tested by emergency happenings—which govern none the less definitely for being themselves ill-defined and subject to variable estimate. But after only a few such examples are examined it is easy to perceive that in every other piece of engineering as well, a controlling influence is exercised by the requirements of unforeseen, abnormal service.

Sound engineering, then, rests on the ability to foresee and shrewdly appraise future contingencies. The necessary knowledge is not to be drawn from books, however, nor does the young engineer obtain it in college. Many, in fact, fail to get it even in the school of experience, perhaps because in their makeup they lack an essential of engineering sense.

It is in observing engineering work—old as well as new—and in studying current engineering literature that the individual engineer finds the best aid to his native good judgment, in developing the ability to allow for the unexpected. The part played by current literature in this education constitutes, in fact, one of its highest elements of value.

Whatever the means of self-training he may choose to employ, however, the engineer who aims to measure up to his professional responsibilities to the world must progress steadily in the ability to foresee contingencies and provide for them sufficiently but not excessively.

Size vs. Specialization in the Colleges

NOT LONG AGO the presidents of Princeton and of Johns Hopkins universities announced that they were seriously considering the limitation of the number of students. Johns Hopkins is short of funds; Princeton believes that it cannot preserve its present individuality if its numbers are increased indefinitely. The thought of the Baltimore institution is based solely on restricted means; Princeton's thinking takes a different turn, and connects itself naturally with Arthur E. Morgan's plea for college specialization, as advanced in his recent article in the *Engineering News-Record* on the new Antioch plan. The Princeton president suggests that candidates for admission might be selected not on mere scholarship qualifications, but on the "Rhodes' scholarship idea," that is, on a demonstration in their earlier school work that they have qualities of leadership and have formed the habit of study. The leadership in the Rhodes' idea is naturally the leadership of action, and so Princeton's specialty would be the training of leaders in the active phases of life. Johns Hopkins' limitations would also require selection, selection would logically suggest specialization, and that specialization would, in accordance with the university's traditions, be along highly intellectual and research lines.

In both cases the thinking is to be welcomed. The universities have sinned just as grievously as the less thinking elements of the community in their striving after bigness. University greatness has been consideed proportionate to size. The result has been inevitable—the spreading of available resources so thinly that it has not been possible to maintain high-grade faculties. Whatever diverts the trend of university development from the quantity back to the quality idea will be of great help to the country, for the universities and colleges are centers of great influence and what they think today is felt in the world at large tomorrow.

We know well the objection that will be made, particularly in the state-supported institutions of the Middle West, against restriction of student bodies. The argument is that the state is obligated to furnish to each of its citizens, equipped therefor and desiring it, a thoroughgoing college or university training, and that the university has a public duty to meet whatever demands are made upon it for new courses.

But there is an argument that runs in a counter direction. If the university has an obligation to provide means of higher education, it is also under obligation to spend with the utmost efficiency the funds placed at its disposal. To erect not only courses, but whole departments and schools, that after ten years' operation turn out only a handful of students annually, when institutions in neighboring states have thoroughly matured departments of the same kind, cannot be considered a businesslike use of the funds that the state makes available. We see no great hardship in forcing a student to go several hundred miles into another state if he can thereby benefit from the superior teaching brought about through many years of specialization in a particular subject. Not only will the student personally be the gainer, but his own local institution will be able to concentrate its funds on fewer courses, to their manifest improvement.

Mr. Morgan made his plea for specialization in the small college. The thought applies equally well, however, to the big institution. In the Middle Ages the university could well be the teacher of all knowledge, though even then certain schools had built up reputations in certain subjects. In this terribly complex age however, the call upon any one institution to teach everything is manifestly impossible of fulfillment.

Economy in Public Works Planning

DESPITE the engineering difficulties and unpleasantnesses created by the refusal of the Detroit city council to award contracts for the Belle Isle Bridge, the judicially minded will perceive that the council's striving for economy in a large undertaking is in tune with the spirit of the times. The present is a time for wise thriftiness, as everyone knows from his own private affairs. Moreover, governments are as much subject to the commandment of thrift as are individuals, and therefore it is natural to sympathize with those who insist that the Belle Isle project be brought within the original estimate despite price inflation. Even in engineering matters it is often possible and proper to make one dollar do where a fuller purse would have willingly appropriated two.

Were the officials not justified by the general need for studied economy their holdup of a needed improvement would merit condemnation, especially now, when construction activity is uncomfortably scant. Engineers know that regular prosecution of public-works construction is vital to the well-being of a large fraction of the nation's organism, and that whatever hampers or delays such construction is of evil. Because of this very knowledge, however, engineers are peculiarly obligated to see that the planning of public improvements is done in conformity with financial as well as the purely technical conditions. It is as much their duty as it is that of administrative officials to take note of the slimness of the public purse, to hear the grumbling of the people at oppressive tax burdens and increasing bond-issue obligations, and to guide public expenditures along lines of economy and efficiency. If they do not give active initiatory service in this respect engineers can not expect to lead, but must needs continue to take orders.

Of the numerous unusual elements of the Belle Isle bridge case, summarized on page 452 of this issue, the latest development—the order to the engineers to revise the plans by modifying details—is significant. The expectation appears to be that upwards of a million dollars can be saved by detail modifications. This would mean that nearly one-third the cost of the whole project was incurred for two or three subsidiary items of architectural effect, such as avoiding cantilever sidewalk construction and walling the approaches. So large a ratio of cost of æsthetics to basic structural cost is surprising, when considered in the light of the principle that æsthetic effort is to be sought in the manner of attaining a desired structural objective rather than in the addition of costly beautification. It may be, however, that the Belle Isle project is not for a bridge but for a piece of park architecture, which would alter the case. Viewing a bridge as an essential object is rather different from viewing it as an incident in park or other architectural development.

Because of its numerous knotty technical questions the case will doubtless be followed with general interest until its final settlement. It is to be hoped that the decision of the several questions will be left to engineers. From present indications the final outcome is bound to represent an effort toward economy of cost and this should mean increased structural efficiency.

Redesign of Belle Isle Bridge to Reduce Cost

Arch Structure Proposed Because Bids on Adopted Cantilever Design Exceed Available Funds—Arch Type Held Liable to Injury From Settlement of Pile Foundations in Clay—Revise Cantilever Plans

WITHIN the past four months two separate sets of bids for construction of the monumental Belle Isle bridge projected by the city of Detroit exceeded the bond issue voted by the people a few years ago, and the city council has in each instance rejected all bids. This condition has created a knotty problem as to how the city is to obtain the bridge without further postponement, and yet within the sum voted; at the same time a sharp engineering controversy has arisen over the matter through the events reported in our news pages Jan. 27, p. 190; Feb. 24, p. 359· March 3, p. 396, and March 10, p. 442.

CANTILEVER SPAN OF ARCH APPEARANCE, BELLE ISLE BRIDGE

Devised by the commission of 1917 because it considered a true arch not permissible in view of the risk of foundation settlement, this design has proved too costly to come within the funds voted for the bridge by the citizens of Detroit. As a result one of the major municipal projects of the year is in an impasse, and Detroit engineers are busy discussing what should be done, especially since Daniel B. Luten submitted a design for a reinforced-concrete arch bridge. Both designs propose to found the piers on piles at similar loading, and both involve eccentric footing pressure.

Because of the importance of both the administrative and the technical questions involved, and the desirability of placing them before the engineering profession with a view to aiding in their clarification, *Engineering News-Record* requested H. H. Esselstyn, of the firm appointed as supervising engineers for the bridge, L. M. Gram, who was engineer to the commission that decided upon the design three years ago, and William H. Adams, at whose instance an alternative design was presented a month ago, to state the essentials of the situation as regards the official design, the foundation conditions, and the alternative design. Statements by Mr. Esselstyn and Mr. Adams follow, together with a summary of the facts and conclusions concerning the foundation. This latter has been prepared from data supplied by Mr. Esselstyn and quotations from the original commission report, to which Prof. Gram referred our request.

Briefly reviewed, the case rests on these facts: That the commission concluded the subsoil to be not dependable enough to make it wise to bring arch thrusts to bear on it, and therefore adopted a steel-concrete cantilever design comprising steel frame "umbrellas" projecting both ways from the piers, and short I-beam connecting spans, all embedded in concrete; that this design, which necessarily involves a large tonnage of structural steel, proves to be excessively costly at present; that a concrete arch design was laid before the city council recently which, though the precise cost figures are in dispute, is very much cheaper than the official design; that the local engineering society protested to the city that a cheap or unsubstantial structure is not wanted, and asked that a board of engineers be appointed to pass on designs; and that the council has requested the supervising engineers for the bridge to prepare a modified—cheapened—cantilever design.

Development of Official Design and Its Revision

BY H. H. ESSELSTYN
of Esselstyn-Murphy, Detroit, Supervising Engineers for Belle Isle Bridge

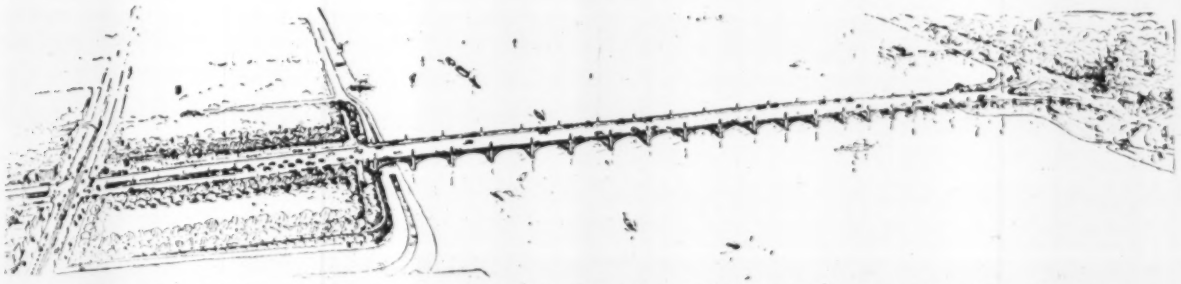
IN THE SITUATION that has been created by the failure to award contracts for the construction of the Belle Isle bridge, on two occasions during the past winter, and the more recent proposal of a substitute design totally at variance with the principles laid down by the commission of engineers that developed the present design, it is important to set down the fundamental reasons why the structure was designed as a concrete cantilever, and what is involved in the present situation.

Thorough investigation of the project for a bridge for the Belle Isle site was made by a commission of engineers appointed in 1916, which after a year and a half of study rendered its report in November, 1917. The commission was composed of Mortimer E. Cooley (ch.), Francis C. McMath, William R. Kales, Emil Lorch, and Henry R. Riggs. Lewis M. Gram was chosen as engineer. Mr. Lorch acted as architect to the commission. On May 1, 1918, George H. Fenkell, commissioner of public works, recommended the design developed by the commission to the city council, and it was subsequently adopted. Since that time no other project or design has been in question but that of the commission.

The foundation problem was of fundamental importance in the commission's study, and special investigation of soil conditions was made by borings, pile tests, and the like. (See preceding article.—EDITOR.) As a result of careful scrutiny of the data, the commission decided that the following requirements must be met by the structure: (1) It should be as light as possible; (2) the foundation reactions must be entirely vertical. A pile loading of 18 tons was recommended, though the detail design has been made on the basis of 14 tons dead load per pile, no live load considered.

Prior to this conclusion, the commission considered some ten different types of structure, including the reinforced-concrete arch type. They included: Plate girder with cantilever sidewalk, steel truss with alternate cantilever spans, steel truss simple spans, concrete arch, steel two-hinged arch, concrete two-hinged arch, steel three-hinged arch, concrete three-hinged arch, open steel cantilever, and finally concrete cantilevers, the latter type being ultimately adopted.

All the types were considered with and without cantilevered sidewalks, and the final choice was in favor of the design with the outer rib placed under the outer edge of the deck, so that the concrete work of the piers could be carried up through the structure in order to



BRIDGE AS PLANNED BY THE 1917 BOARD OF ENGINEERS—CANTILEVERS AND SUSPENDED SPANS

give a more effective architectural development than can be obtained with cantilever sidewalks, where the pier feature could not be carried above the balustrade.

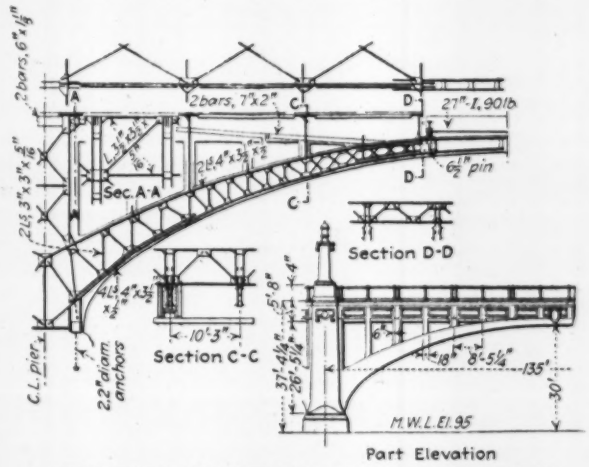
Upon the decision to base the choice of type on the two principles stated above, the arch designs were necessarily eliminated. That it is untenable from an engineering standpoint to consider for a moment a reinforced-concrete arch bridge for the site was moreover brought out very emphatically by the preponderance of evidence against the arch bridge proposal at the public hearing before the council three weeks ago, when a number of engineers presented their views.

As originally estimated by the commission, the cost of the bridge would have been less than $3,000,000, including the Jefferson Ave. subway in the north approach. A bond issue of $3,000,000 was subsequently voted by the people in a referendum election, and later the writer's firm was appointed as supervising engineers for the design and construction. In the preparation of contract plans the commission's general design drawings were closely followed, yet in bids received for parts of the work last November a total cost of $5,000,000 was indicated, and in bids received after readvertising the lowest bid was about $4,500,000, exclusive of the subway, as compared with a sum of $2,500,000 available after final payment for the subway approach contract already in process of construction. It was subsequent to the refusal of the city council to award contracts on these bids that the proposal of designs for a reinforced-concrete arch structure was made to the council by an outside engineer.

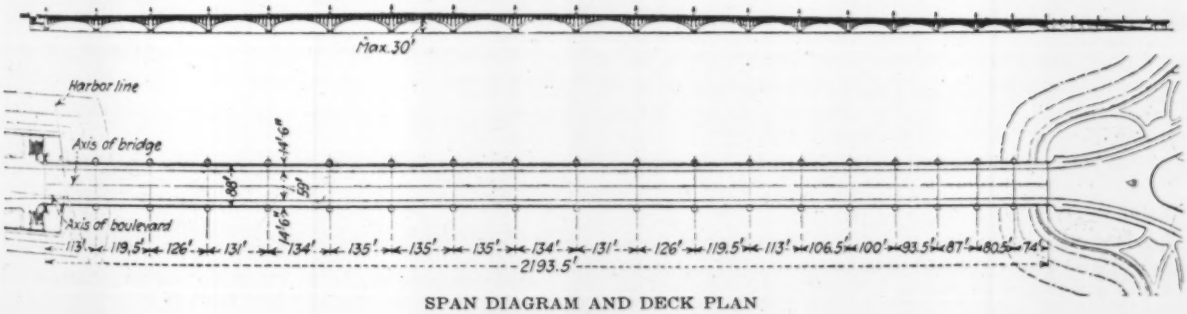
The latest official act of the council on the matter was the passing of a resolution on March 1 recommending "that Esselstyn-Murphy be authorized and directed to make such modifications of the original reinforced-concrete cantilever bridge recommended by the Belle Isle Bridge Commission as will bring the cost within the balance of approximately $2,500,000 remaining, such modifications to consist of the elimination of approaches and the substitution of dirt fill therefor and such other changes as may be deemed necessary." The resolution was subject to veto, but the time for such a veto has now passed, and work is already in progress on the modified design called for in it. The new design will be ready for presentation to the council in a month.

The commission had made a study of the structure with cantilevered sidewalk, as already stated, and it is this design we are now coming back to, because of its economy over the official design. In the modified design no sacrifice is being made as regards carrying capacity, stability, or the like.

However, it should be emphasized that the matter of changing the design of the bridge is a very delicate one, and we as engineers for the bridge have all along fought to have the original commission reappointed and kept in office until the structure is completed. This has not as yet been done and we have been instructed by the resolution just quoted to prepare a modified design. It is proper to say that we are treating with the most careful consideration the original accepted design, and we believe that by adopting one of the original designs considered by the commission we are acting in the spirit of those who carried out the fundamental engineering studies.



STRUCTURE AND STEEL FRAME OF CANTILEVER

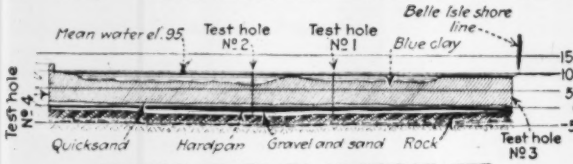


SPAN DIAGRAM AND DECK PLAN

Soil Conditions Back of Cantilever Design

AT THE site of the bridge, rock occurs 103 to 125 ft. below water level, and the main part of the overlying soil is blue Detroit clay, a material that often proves troublesome. The foundation problem being of first importance, whatever the type of bridge chosen, special investigation of the underlying soil conditions was made by the commission, by means of borings and test piles, the results being checked against data obtained from others who had made similar surveys in Detroit.

For a depth of 90 ft. below water, a light blue clay of nearly uniform hardness, containing fine sand in



PROFILE OF STRATA AT BRIDGE SITE
One hundred feet of clay, hardpan and sand overlie rock.

spots, was encountered; in one hole near the middle of the river a 7-ft. quicksand layer was found at 90 ft. depth. The pile-driving records for the temporary bridge nearby also indicated softer material near the middle of the river. At 100 to 110 ft. hardpan was encountered, and below this generally some 10 ft. of sand and gravel over rock. The profile developed is shown herewith.

It was considered impracticable to extend foundations through 30 ft. of water and 90 ft. of the more or less plastic clay to bedrock, especially in view of the great cost of caisson work in Detroit, where gas and quicksand pockets are often encountered in the clay, producing considerable trouble. Common practice in heavy work along the water front is to drive wooden piles into the clay and on top of these to cast a concrete mat. It was decided by the commission that this would be the only feasible type of foundation to be used.

Pile tests were made with piles of 15-in. butt diameter and 8-in. point, driven to 51 ft. penetration. Four test piles driven by steam hammer showed penetrations of 0.27 to 0.38 in. per blow at 40 ft. penetration; one of them, driven continuously to 50 ft., showed a final penetration of 0.18 in. per blow, and another, driven to 50 ft. after 20 hrs. wait, showed a final penetration of 0.05 in. per blow. This last-mentioned pile was placed under test load two weeks later; under 20 tons its settlement was 0.023 ft. in 14 days, increasing to 0.035 ft. after 32 days, while under 42 tons the settlement increased to 0.074 ft. the first 15 days and to 0.124 ft. in 58 days. None of these piles extended below the blue clay. These results led to the conclusion that piles "would carry 18 to 20 tons without serious progressive settlements." A loading of 18 tons was recommended for design.

As the result of its foundation studies the commission formulated the two principles quoted in the article of Mr. Esselstyn (p. 452), and shaped its decision of bridge type thereby. The commission said:

"Arches and cantilevers are types which economically follow pleasing lines, and therefore investigation of their relative adaptability was made by means of sketches and estimates of costs. Two-hinged, three-hinged and hingeless arches were considered, and while each has its advantages, all are dependent for stability upon lateral resistance of the soil. Furthermore, an intelligent analysis of stresses must be based upon assumed and uncertain displacements of the piers. For these reasons and in view of the soil conditions, as described above, a structure based upon the cantilever principle with vertical reactions is considered preferable."

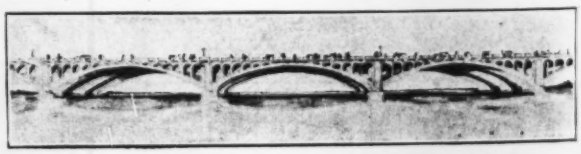
Summarizing its choice of design, the commission stated that its foundation studies "indicate that a structure designed upon cantilever principles would best fit the natural conditions. Other structural types were carefully considered but the great distance to rock and the plastic condition of the overlying soil were the most important eliminating factors. Moreover the curved arms of the cantilever construction give pleasing lines consistent with the character of the bridge as a civic and park structure. The water level is subject to slight changes, hence the curved arms can spring from the piers at a low point and an open-spandrel treatment is practicable, giving an effect of lightness without sacrificing that of strength and dignity. The advantages with respect to appearance as well as permanence were deciding factors in the selection of reinforced concrete as the most suitable material."

Data of Reinforced-Concrete Arch Design Recently Proposed

By William H. Adams
Consulting Engineer, Detroit

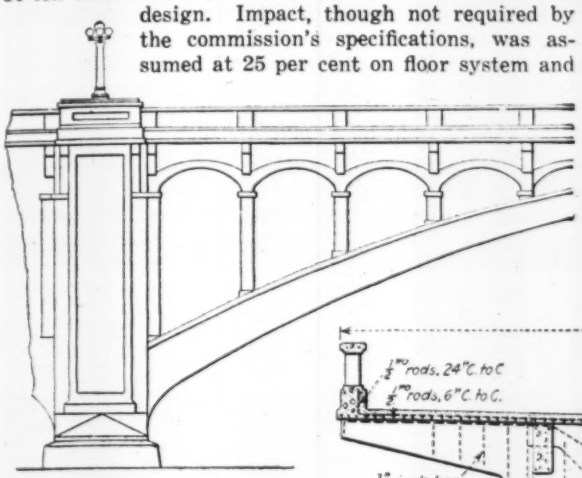
THE official design for the Belle Isle bridge, of structural-steel-and-concrete cantilever type, was twice advertised in the fall of 1920. The lowest bids ran nearly $2,000,000 over the funds available, and the city council rejected all bids. Matters stood thus when at the writer's suggestion the council granted a hearing on Jan. 14 to Daniel B. Luten on a proposed modification of the bridge program, and Mr. Luten presented preliminary sketches for an arch bridge which he stated should be built within the funds remaining from the $3,000,000 bond issue—about $2,500,000. By resolution the council thereupon permitted Mr. Luten to submit, within thirty days, detailed plans, specifications, and estimates, with the understanding that all general requirements of the bridge commission's report be met as to strength and capacity and that the bridge should have the same general appearance as that provided in the official plans.

Estimates of cost submitted in accordance herewith, accompanying a set of detail plans, ranged from $2,486,360 for an earth-filled arch and the official approach design to $2,175,725 for an open-spandrel arch design with modified south approach. The open-spandrel design, described in the following, approaches closely in appearance the commission's design. The alternate design for the approach at Belle Isle saves about $140,000 by broadening out the fill and eliminating the ramps and retaining walls.



OPEN-SPANDREL ARCH DESIGN FOLLOWS LINES OF COMMISSION DESIGN

Sixteen spans of 95 to 160 ft. in the clear form the river crossing in the open-spandrel design, three channel arches having clear spans of 160 ft. and a clear rise of not less than 30 ft. The roadway width (85 ft between railings) and the loading (100 lb. per sq.ft. with provision for concentrated loads of an 18-ton truck or two 50-ton street cars on each track) are as in the official design. Impact, though not required by the commission's specifications, was assumed at 25 per cent on floor system and



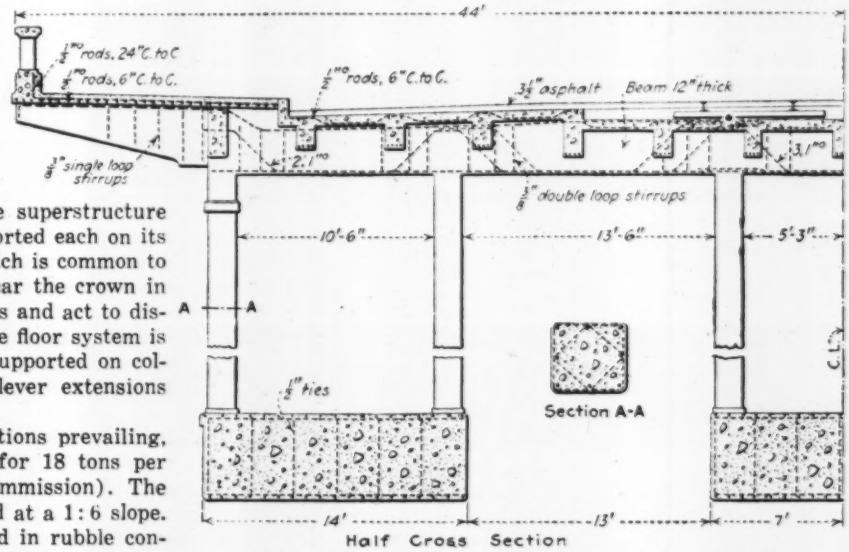
zero on arches and piers. The superstructure comprises three arch ribs supported each on its unitary pier down to a base which is common to all. Two transverse girders near the crown in each span connect the three ribs and act to distribute concentrated loads. The floor system is carried on transverse girders supported on columns from the arches; cantilever extensions support the sidewalk.

On account of the soil conditions prevailing, the foundations are designed for 18 tons per pile (as recommended by the commission). The outer rows of piles are battered at a 1:6 slope. The top 3 ft. is to be enveloped in rubble concrete, laid under water, the top of this mat being at the elevation of the bottom of the mat of the official design. Above this is a 6-ft. mat of reinforced concrete, 93 ft. long and of width varying with the span.

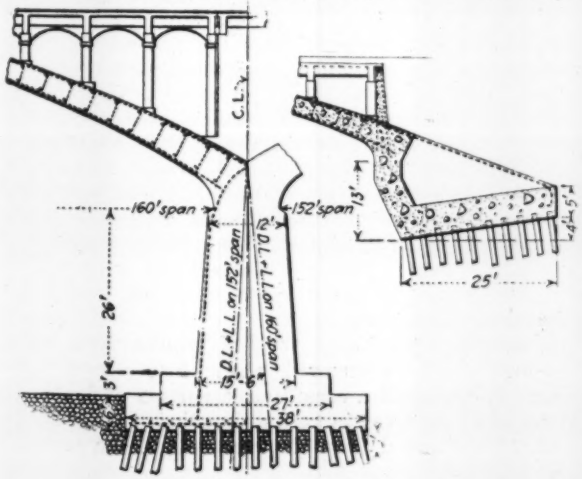
The piers are designed for one span fully loaded and the adjacent span unloaded, analyzing the piers by the elastic theory, considering arch and pier as one elastic system; or, one span half loaded, adjacent span unloaded, analyzing by the gravity method, arches as though unattached. The piers are located so as to avoid all the old piers of the earlier bridge, which are to be removed. There is no necessity for much provision against scour, as the current is sluggish and the river levels uniform.

As the longer spans have the greater rise, the thrusts for uniform loads are approximately equal. Unbalanced thrusts are slight as compared with the total load; they are fully provided for by the battered piling. The deepest pier will extend 35 ft. below water line. As it is intended that the 9 ft. of base and sub-base concrete shall act as a seal for the cofferdam, this deepest pier will have 26 ft. of pumpage.

The economies of the design consist in the elimination of over 4,000 tons of structural steel trusses and bracing,



ELEVATION AND CROSS-SECTION OF 160-FT. ARCH SPAN



ARCH FOUNDATION AND PIER CONSTRUCTION

bolts and anchors, and 1,300 tons of steel sheetpiling; a reduction in concrete from about 63,000 cu.yd. to about 50,000 cu.yd., with a greater simplicity of construction and detail; the use of concrete railing throughout; simplified drainage, waterproofing and lighting, and a more economical system of centering.

Track Maintenance by Piece Work

Owing to the abnormal conditions under which maintenance of way work has been conducted during the past year, no considerable amount of maintenance of way work has been handled under contract or piece work schedules, according to the report of the Committeee on Track of the American Railway Engineering Association. The standard track work system which was in effect on the Baltimore & Ohio R.R. and the Pennsylvania R.R. had as one of its essentials the establishment of unit performance or piece work schedules, but this system was abandoned by the U. S. Railroad Administration and has not been re-established. Many roads resorted to the cost-plus form of contract in handling maintenance work during the past year, but in effect this plan was little more than the recognition of the contractor as a labor agent, the work being done as heretofore under the immediate direction and supervision of the regular railway officers.

Proportioning Concrete on Job by Exact Methods

Development of Water-Cement Ratio and Surface Area Theories Permit Changes of Proportions to Produce 35,000 cu.yd. of Concrete of Desired Strengths

By R. B. Young and T. V. McCarthy

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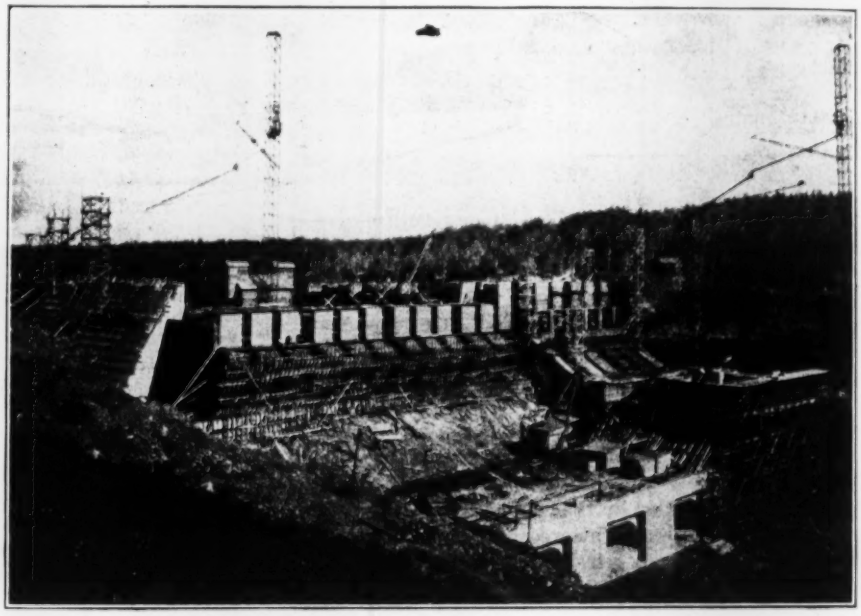
Chief Field Inspector, Niagara Power Development, Hydro-Electric Power Commission, Niagara Falls, Ont.

In *Engineering News-Record*, Jan. 1, 1920, p. 8, one of the authors of this article described a method of proportioning concrete which had been developed by the Hydro-Electric Power Commission of Ontario and was then in use on their work. This method was based in part on Prof. D. A. Abrams' water-cement-ratio-strength-relation and in part on L. N. Edwards' researches on proportioning concrete mixtures by surface area.

In the year just past, this method has yielded very satisfactory results on the construction of a hydro-electric power development in Northern Ontario where approximately 35,000 cu.yd. of concrete were placed. Despite many unfavorable conditions, concretes of the specified strength were secured and it was found possible at all times to set a mix which would give a compressive strength within a few hundred pounds of the value sought.

A brief description of the job will help to make clear the conditions which had to be met. The work consisted of the construction of a hydro-electric power plant and dam at Cameron Falls on the Nipigon River about fifteen miles north of that river's entry into Lake Superior. The ultimate development at this point will be 75,000 hp., but only 25,000 hp. is being developed at this time. The head available is 78 ft. The construction involved some very complicated reinforced-concrete work including two turbine scroll cases and nineteen heavily reinforced piers. A general view of the development under construction is shown.



GENERAL VIEW OF NIPIGON POWER DEVELOPMENT WHERE 35,000 YD. OF CONCRETE WAS PLACED

Two concrete mixing plants of conventional design were used. Both were equipped with overhead bins, separate measuring hoppers and twin mixers. The concrete was placed by means of towers and chutes, which are shown herewith in a view of one of the mixing plants.

With the exception of the cement, the materials for the concrete were obtained locally, the sand from deposits close to the work, the crushed rock from stone obtained from the power-house and tailrace excavations, crushed to the required size on the job.

Each of these materials complicated the problem of determining the proper proportions to be used for the different qualities of concrete. Because of the peculiar conditions existing last year in the cement industry, it was necessary to obtain supplies from six different mills. Contrary to popular opinion, cements from different sources have different cementing values and this introduced an added variable difficult to estimate.

All cement shipments were sampled at the mills by a representative of the commission and either tested there or at the commission's laboratories at Toronto. By this means it was usually possible to accept or reject the cement before its arrival at the job and this permitted its use directly from the cars, a considerable advantage where storage facilities were limited and labor of all sorts both scarce and costly.

The sand was obtained from two sources, a gravel pit and a sand pit. Material from the former had to be washed and screened and this screened sand was, until it gave out, mixed with the pit sand to improve the grading. This gave rise to a much greater variation in the grading of the fine aggregate than would otherwise have been the case and made proportioning more difficult. In addition the pit sand was fine and micaceous and required the use of more cement to obtain the desired quality of concrete than a better graded sand would have done. The sand was sampled daily and its mechanical analysis, moisture content and weight per cubic foot determined.

The stone used was a crushed granite from which the dust had been removed, screened to pass a 2½-in. ring. It contained a considerable portion of low-grade stone which occurred in such a way that it could not be entirely eliminated from the rock sent to the crushing plant.

A small laboratory was installed on this work and was

equipped with an inexpensive 100-ton hydraulic type testing machine, sieves for the analysis of sand and stone and miscellaneous apparatus for determining their weight per cubic foot, moisture content, cleanness and freedom from organic impurities. A small building was erected to house the apparatus and for the storage of the concrete test specimens.

Inspection covered both materials and operations. The materials were not only tested but a watch was kept on the sand and gravel pits, washing plant, crusher and stock piles. The inspection of concreting operations included all details in connection with proportioning, mixing and placing. An effort was made to see that all materials were accurately measured, that the batches were properly mixed and that the chuting plant was arranged so as not to interfere with the quality of the concrete delivered. Inspection was also maintained on the placing of concrete in the forms, spading, cutting off of laitance and removal of forms.

TABLE I. CEMENT-RATIO AT NORMAL CONSISTENCY AND WATER-CEMENT RATIO CORRESPONDING TO CLASSES OF CONCRETE SPECIFIED FOR NIPIGON POWER DEVELOPMENT

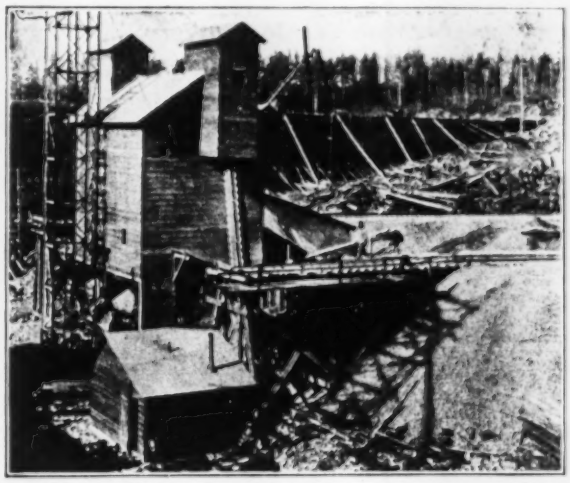
Class	Minimum Specified Compressive Strength in Lb. per Sq.In.	Cement, Lb. per 100 Sq.Ft. Surface Area Normal Consistency	Range of Water-Cement Ratio (by Weight) Min.	Max
A	2,500	2 60	0 54	0 58
B	2,000	2 25	0 62	0 68
C	1,500	1 80	0 73	0 88
D	1,000	1 30	0 85	0 91

Test specimens of concrete, three to a set, were taken from time to time as circumstances demanded, their frequency depending on the amount of concrete placed or on changes in the materials, consistency or class of concrete used. These specimens were made from the wet concrete in the forms. A number of samples were taken at different places from a depth of several inches below the surface, carried to the laboratory, dumped on a batter board, turned over to rectify any segregation which might have occurred in transporting to the laboratory and then immediately placed in 8 x 16-in. steel cylinders. These specimens were stripped, usually in 24 hours, and then stored in moist sand until broken. Generally one of each set was tested when seven days old, the others when 28 days old.

Three classes of concrete, called for convenience Classes *A*, *B* and *C*, were in use on this work. Class *A* was specified as being of such quality as to show a minimum compressive strength of 2,500 lb. per square inch at the age of 28 days when tested in accordance with the standard methods of the commission. Classes *B* and *C* were required to have minimum compressive strengths of 2,000 and 1,500 lb. per square inch, respectively, under the same conditions.

The test data used in the design of these concretes is given in Table I. Here is shown the relation between surface area of aggregate, cement and water for each class of concrete, for the materials used on this work. The cement requirement is stated for a normal consistency mixture in terms of the number of pounds of cement per 100 sq.ft. of surface area of the combined sand and stone and the water is stated in terms of its relation to the cement in the mixture or water-cement ratio.

The cement required per batch for a normal consistency mixture can be determined from the mechanical analysis of the aggregates used, their weight per cubic foot and the quantity of each in the batch, as described



CONCRETE PLANT NO. 2 WITH STOCK PILE AT NIPIGON

in the previous article noted. The water required per batch is obtained by multiplying the amount of cement required per batch by the proper water-cement ratio. This is the maximum quantity of water per batch which can be used. The water present in the aggregate must be deducted from this maximum allowable quantity to obtain the amount of water which is to be added at the mixer in gaging. The proper deduction is determined by reference to the tests for moisture content made daily on the aggregates. If the quantities of cement and water are thus determined, the resulting mixtures will be of a uniform consistency and the finished concrete will have the required compressive strength.

Normal consistency is a consistency which has been arbitrarily chosen in the laboratory and represents approximately the driest mixture which can be placed under best field conditions. Any other degree of plasticity either drier or wetter can be obtained without appreciably affecting the quality of the finished concrete by increasing the cement and water content proportionately. A consistency which required 15 per cent more cement and water than did this normal consistency has been found suitable for chuted concrete and was used largely on this work.

Water-cement ratio as ordinarily defined is the ratio of the volume of water to the volume of cement. As here used it is the ratio of the weight of water to the weight of cement. Using the volumetric water-cement ratio in practical proportioning gave rise to considerable confusion which has been almost entirely overcome by a change to the weight basis.

On this job some 80 sets of test cylinders were taken representing 36,000 cu.yd. or approximately one set for each 450 cu.yd. Many sets represented as little as 50 cu.yd., others as high as 700 cu.yd. On several occasions test specimens were taken but every second or third day when conditions were uniform and in the judgment of the engineer in charge of concreting daily samples were unnecessary.

In Table II have been tabulated the test results obtained from 53 sets of test specimens covering a period of 4 months or 48 days of actual concreting and representing 21,000 cu.yd. of concrete. The proportions are given in volumes and the standard Canadian bag of cement weighing 87½ lb. is considered to contain one cubic foot. The change in proportions made from time

TABLE II. RESULTS OF TESTS ON SPECIMENS OF CONCRETE PLACED FROM MAY 1 TO OCT. 1, 1920, ON NIPIGON POWER DEVELOPMENT

Date	Proportions (Volumetric)	Water-Cement Ratio (Weight)	Compressive Strength Lb. per Sq.In. 7 Days	28 Days
	Class A			
June 5	1:2 5:3 0	0 54	.....	2,330*
June 6	1:1 8:3 2	0 55	.....	2,660*
June 11	1:1 7:3 2	0 54	.....	3,360*
June 16	1:1 8:3 2	0 54	2,360	3,415
June 27	1:2 4	0 57	2,190	3,288
June 30	1:2:3 9	0 57	2,740	3,238
July 7	1:2 1:3 4	0 573	2,181	3,050
Aug. 3	1:2-1:6	0 51	1,655	2,545
Aug. 3	1:2 2:3 7	0 56	1,509	2,982
Aug. 5	1:2 2:3 7	0 56	2,281	2,902
Aug. 11	1:2 7:4 0	0 60	2,790	2,820
Aug. 19	1:2 25:3 67	0 59	1,125	3,505
Aug. 20	1:2 25:3 67	0 575	1,535	2,225
Sept. 2	1:2 2:3 8	0 573	1,221	2,525
Sept. 2	1:2 2:3 8	0 573	1,442	2,830
Sept. 4	1:2 2:3 8	0 573	1,194	2,352
Sept. 8	1:2 2:3 8	0 59	1,235	2,396
Sept. 9	1:2 2:3 8	0 59	1,390	2,625
Sept. 13	1:2 2:3 8	0 583	1,203	2,468
Sept. 13	1:2 2:3 8	0 583	1,307	2,477
Sept. 15	1:2 2:3 8	0 583	1,280	2,465
Sept. 16	1:2 2:3 8	0 583	1,115	2,085
Sept. 21	1:2 2:3 9	0 60	634	2,535
Sept. 24	1:2 2:3 9	0 60	927	2,425
Sept. 24	1:2 2:3 9	0 60	1,100	2,445
Sept. 30	1:2 2:3 9	0 60	1,173	2,363
	Class B			
May 24	1:2 5:4 5	0 60	.....	2,535*
May 28	1:2 5:4 5	0 60	.....	2,560*
May 30	1:2. 0:3 1	0 55	.....	2,460*
June 2	1:2 0:3 1	0 55	.....	2,430*
June 9	1:2 5:3 65	0 60	.....	2,110
June 11	1:2 3:3 8	0 60	1,314	2,270
June 15	1:2 3:3 3	0 60	1,512	2,937
June 20	1:2 3:3 3	0 6	961	2,032
Aug. 14	1:3 0:5 5	0 61	1,990	2,821
Aug. 17	1:2 6:4 6	0 643	1,395	2,605
Aug. 26	1:2 6:4 4	0 675	755	2,180
Aug. 28	1:2 6:4 4	0 665	835	1,365
Sept. 18	1:2 6:4 6	0 643	1,354	2,060
Sept. 25	1:2 2:3 9	0 64	1,030	1,683
	Class C			
May 13	1:2 3:4	0 56	.....	1,640*
May 30	1:2 5:4 5	0 72	.....	1,835*
June 14	1:3:5	0 72	1,300	2,125
June 29	1:3:5	0 80	1,310	2,090
July 7	1:3 2:4 5	0 80	1,110	2,592
July 17	1:3 0:5 4	0 80	395	1,430
July 20	1:3 3:5 5	0 80	1,680	1,927
July 30	1:3 3:5 5	0 75	1,062	1,630
Aug. 7	1:3 3:5 5	0 785	1,180	2,335
Aug. 10	1:2 9:5 0	0 77	1,390	2,062
Aug. 12	1:3 3:5 5	0 77	1,250	2,752
Aug. 13	1:2 6:5 5	0 71	1,180	2,125
Aug. 22	1:3 3:5 5	0 80	1,100	2,022
Aug. 24	1:3 3:5 5	0 80	398	1,437

† Tested when 8 days old.
* Average of tests on three cylinders.

to time correspond to changes in the aggregates in use or changes in the consistency. The 7-day values are the result on only one cylinder, the 28-day values, except where otherwise noted, are the average of two.

Our experience on this and on several smaller jobs has led us to the conclusion that good concrete requires not only proper materials properly proportioned and the right equipment properly handled but also close supervision and inspection of all details of concreting by men who are conversant with both the theoretical and practical phases of their work.

Our experience has led us also to believe that every step taken to eliminate guesswork in the process of concreting is a step toward the ultimate goal of a uniform and controlled product and to this end have been adopted the field laboratory, the periodic tests of aggregate and concrete, the method of proportioning outlined and the continuous inspection by experts. The results obtained appear to justify this conclusion.

As a proof of confidence in this system of controlling the quality of concrete, the commission is now making the necessary arrangements to carry out the same procedure on a 500,000-hp. hydro-electric development at Niagara Falls. It is confidently expected that as a result of this care, better concrete will be obtained at a less cost than would be possible under the usual system.

Precipitation from Treated Boiler Water

From report of Committee on Water Service, American Railway Engineering Association. Prepared by C. H. Koyl.

IN THE EARLY DAYS of water softening in this country it was noticed that after water had been through the process, there was a deposition of flakes of carbonate of lime found on standing. It became evident that the chemical reactions had not been completed in the softening plant and that the lime (to mention only one reagent) had not been thoroughly mixed with the water. I made a series of tests to determine the amount of mechanical mixing necessary to effect a softening down to 3 grains per gal., at which point the reactions in ordinary water are nearly complete, and found it to vary from 25 min. in clean well water at 60 deg. F. to 50 min. in river water at 45 deg. The addition of a 50-min. mixing or reaction chamber as a preliminary to the settling chamber of every "continuous" water softening plant did away with this precipitation, but it was remarked that if the water was undertreated in lime, after-deposition still took place, as untreated water requires much longer mixing than 50 min.

It was noted also that when the best of treated water was fed to locomotive boilers through injectors there was a sufficient deposition to interfere with the operation of the injector. This was not serious in warm weather, when the temperature of the injector does not exceed 212 deg. F. unless the check valve leaks, but it became very serious in cold weather when injectors are kept hot by steam from the boiler. In the winter of 1915-16 there was a treating plant at every water station on the Great Northern Ry. on the line from Devils Lake, N. D., to Shelby, Mont., a distance of nearly 700 miles, and while boiler leaking was unknown there was so much trouble from clogging of the injectors that its prevention became a serious study.

The material deposited in the injectors was calcium carbonate and came from the water at a temperature not far above 212 deg. F. At this temperature the content of calcium carbonate can be reduced to about 2 grains per gallon, but calcium sulphate, if it were present, would not be affected. Therefore, I decided to try to convert at least part of the 3 grains of calcium carbonate in the cold water into calcium sulphate by adding 3 grains per gallon of ferrous sulphate to the water before it left the mixing tank of the treating plant. This would leave in the water a small amount of ferrous carbonate which would give the injector no trouble.

The first test was made at Minot, N. D., where the switch engines had been the subject of continuous complaint. After the water had been treated as above for one month a switch engine was examined and the injector and all its connections were found quite clean. The treatment with ferrous sulphate then began to be extended to all treating plants on the line and the results have been uniformly good. The use of all chemicals employed in treatment of water should be under the supervision of a competent person who understands the reactions involved.

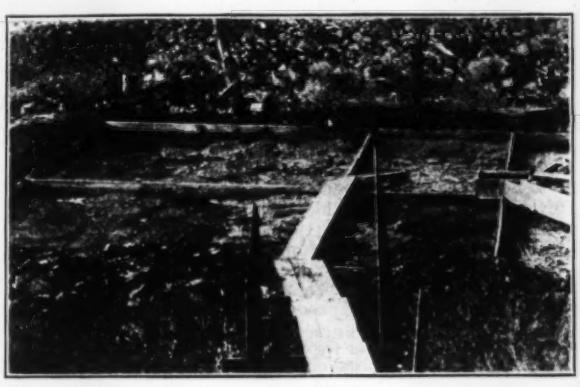
The Basis for Extension of Water Mains

Charges for extending water mains in Terre Haute, Ind., by the water company are based on actual costs according to a paper by Dow R. Gwinn, president of the Terre Haute Water Co., presented recently to the Indiana Sanitary and Water Supply Association. The Public Service Commission allows a return of 8 per cent and 1 per cent for depreciation. Operation and taxes are figured at 10 per cent of the valuation so the rates are fixed to net 19 per cent of the cost. In a city block of 365 ft. in built up territory with six houses the minimum monthly rate should be $1.50 and a fire hydrant for which the city should pay $50. This is on the assumption that a 6-in. main was laid. In real estate additions the land owner should pay the whole cost and be reimbursed by the water company without interest when the income reached the above 19 per cent

Sewage-Treatment Testing Station at Grand Rapids, Mich.

Dortmund Tank Installed in 1919 Transformed Into Dorr Clarifier—Sludge with Paper Mill Waste Dries in 10 to 30 Days

SEWAGE heavily charged with strawboard mill and gas-works wastes is treated at the sewage testing stations at Grand Rapids, Mich., where tests were started in June, 1919. The original Dortmund tank has been rebuilt into a Dorr sewage clarifier. Sludge-digestion tanks for Dortmund or Dorr tanks have been found unnecessary, the sludge drying in 10 to 30 days and then burning easily without odor. On account of foundation difficulties, experiments to reduce the depth to the limit will proceed in 1921. The following notes were obtained (1) from a visit to the plant in November, 1920; (2) from subsequent information from Gerald J. Wagner, commissioner of public works; and (3) from a paper presented recently to the Illinois Society of Engineers by Milton P. Adams.

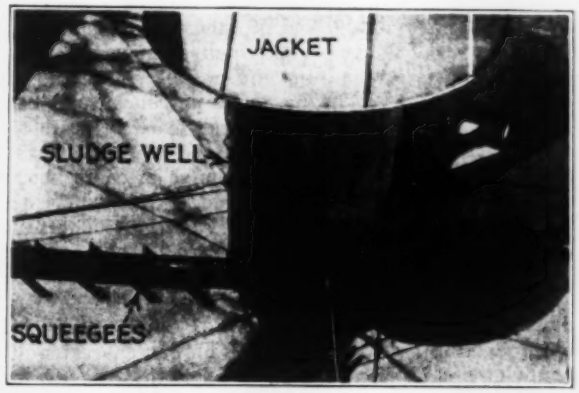


FLAKY DRIED SLUDGE IN FOREGROUND AND NON-FLUID MUSHY SLUDGE IN BEDS

Grand Rapids, a city of 150,000 people, has an average daily water consumption of 100 to 110 gal. per capita. The sewage flow is about 30 m.g.d., one-half being ground water. Of the 17.6 square miles of area, 11.7 square miles are sewered. There are two intercepting sewers on the east side and two on the west side of the Grand River.

The experimental work has not had the wide scope common to sewage testing stations. Rather, it has been an intensive operating study of a life-size sedimentation unit. The problem at Grand Rapids is one in plain sedimentation and sludge disposal, efforts being directed toward the meeting of a State Supreme Court injunction rendered in 1913, calling for the removal of the sludge-forming materials in the sewage before the latter is discharged into the local water course.

The testing station was located at the junction of the East side trunk sewer and the Prescott St. sewer containing strawboard waste. The suction of the 1-m.g.d. centrifugal pump may take sewage from either sewer. Originally the plant consisted of a Dortmund tank, 32 ft. outside diameter and 30 ft. deep, with a hopper bottom having 45-deg. slopes. The sewage entered 13 ft. below the surface and flowed out over the peripheral weir with notches every 2 ft. Adjoining this tank are three sludge-digestion tanks, each 20 ft. in diameter by about 28 ft. deep, with hopper bottoms, and four tanks each 4 ft. in diameter by 26 ft. deep. A sludge-bed area of 40 x 80 ft. is provided, divided into 12 units. The beds are built upon tamped clay. On this are placed underdrain tile, and above the clay and tile are laid 10 in. of cinders and 4 in. of sand.



EMPTY CLARIFIER SHOWING CENTRAL INLET JACKET, SLUDGE WELL AND DORR THICKENER

The present testing station consists of a Dorr clarifier, built out of the Dortmund tank, with a water depth of 14 ft. at the center and 12 ft. at the periphery. The sewage enters at a depth of 5½ ft. The clarifier mechanism (or Dorr thickener) revolves once in 17 min. The sludge well sets 9 in. off the floor, is 11 ft. in diameter at the bottom and narrows to 4 ft. at the top. A small bucket elevator is provided to remove sludge from the well. The advantages of the flaring well over the ordinary cylindrical type are as follows: (1) It increases the area of sludge opening into the well by making the opening equivalent in length to the circumference of a much larger circle. (2) The storage and covering of a larger volume of sludge within the well makes far better conditions in the outer sedimentation compartment and gives greater flexibility in sludge handling. (3) It concentrates as much evolved gas as possible within the well. The beneficial action of the gas in the 4-ft. well had already been noted, both as regards its buoyant effects on the sludge and the drying power it exerts in passing through the upper layers of sludge.

In November the clarifier was handling about 0.8 m.g.d. on a 2-hour detention period. This is equivalent to a rate of 960 gal. per sq.ft. per 24 hours. The tank was removing all the settling suspended matter by the Imhoff settling-glass test. The sampling schedule was intermittent, a 24-hour composite being taken on every fourth day. Based on the data of analyses, the tank was removing from 27 to 59 per cent of the 150 to 350 p.p.m. of suspended matter in the raw sewage. There was a slight grease scum on the half of the tank provided with boards. Inside the sludge well a scum forms which at times averages as low as 75 per cent moisture. The sludge entering the well at the bottom runs 88 to 92 per cent moisture. The total organic nitrogen is low, averaging less than 1 per cent.

During August and September the clarifier treated 18.5 m.g. of sewage with an average removal of suspended solids of 50 per cent. During the next two months of operation this figure fell to 24 per cent. From August to November 48.2 m.g. of sewage was

treated, 2,311 cu.ft. of sludge averaging 83.2 per cent moisture were produced, and of this amount 933 cu.ft. of 79.2 per cent sludge were actually removed by conveyor, the balance remaining in the tank at the end.

On removal the sludge has been put on a sand bed for drying. Fresh Dortmund sludge dried in 10 to 30 days and the so-called digested sludge (3 to 4 months old) dried no faster. The Dorr sludge dried in about the same time. The air-dried sludge was firm with a skin of fine straw on it. A part of the sludge was lagooned. This gave off no marked odors.

The situation is unusual in that the main sewer outlet receives the drainage from a strawboard and paper mill and gas works, located only ¼ mile above the present testing station inlet. The fibrous character of the sludge and its lack of odor indicates that the strawboard and paper mill waste has some influence on the process. A casual inspection of the strawboard mill showed a fine (60-mesh) screen on the outlet of each mixing mill. On the other hand, straw stock was working around the outlet pipes and passing out. The waste had not yet been measured.

The Dortmund Tank

The original Dortmund tank was operated on displacement periods ranging from 1.7 to 5 hours, with flows of 0.4 to 1.1 m.g.d. The upward velocity at the 1.5-hour period was about 12 ft. per hour. The removal of suspended matter over eight months (by a composite of 16 hourly samples on every third day) was 45 per cent. By the cones 95 per cent was removed. In the summer boiling occurred in from 7 to 10 days.

The original 45-deg. slope on the bottom did not prove sufficient; 57 deg. worked much better. The sludge averaged 93 per cent moisture with a minimum of 87 per cent. A sludge containing 94 per cent moisture was found not to move satisfactorily on planed timber slopes of ½ in. to the foot; ⅔ in. to the foot seemed to be required.

In the separate sludge-digestion tanks the sludge has a marked tendency to separate into bottom sludge and top scum even in two or three days. The sludge from the digestion tanks dried in about the same time as the raw sludge (10 to 30 days) to a water content varying from 60 to 70 per cent. The wet sludge applied 14 in. thick dried to 4 in. when removed. This sludge when dried burned readily. The fresh Dortmund sludge contained considerable oily matter and had a strong odor of tar.

As the plant layout permitted the taking of sewage from either fork above the junction, the Dortmund tank was run for five months on the Prescott sewer and three months on the East Side trunk sewer. The Dorr tank, however, has been run on a mixed sewage below the junction.

A summary of the operating results on the Dortmund tank shows that on the Prescott St. sewer the sludge accumulation averaged 7.84 cu.yd. per million gallons with a moisture content of 93.6 per cent and specific gravity of 1.015. On the East Side trunk sewer the sludge accumulation averaged 1.40 cu.yd. per million gallons with a moisture content of 93.3 per cent and specific gravity of 1.017.

On the Prescott St. sewer the periods of flow ranged from 1.7 to 4.1 hours, averaging 2.6 hours. On the East Side trunk sewer the periods of flow ranged from 2.1 to 5, averaging 3.3 hours.

The plant was closed in November, 1920, but it is planned to reopen it in the spring, applying the clarified to a still shallower tank, reduce the sludge opening into the present well and develop an overflow sludge delivery from the bottom of the tank.

From Mr. Adams' paper the following comments are taken relative to "pin-point" boiling, sludge experience and general conclusions:

The surface of the tank in operation represents any quiet body of water over which fine particles of grit or dust are being sprinkled. This is caused by the bursting of minute gas bubbles at the surface. This gas is evolved in the sludge on the tank bottom and released by the periodical moving of the squeegee arms (Door thickener) through the sludge. On shutting down the mechanism in warm weather, this "pin-point" boiling stops altogether — the tank surface is clear for from 8 to 10 hours, while gas is collecting and being retained in the sludge below. Finally, enough gas is entrained to buoy masses of sludge to the surface, where it is released—the action being identical with "tank boiling" experienced in the former Dortmund tank. On shutting down for a few days in June a 6-in. leathery scum of sludge formed over the tank surface in 24 hours. Thus the necessity of the operation of some kind of agitator in a tank of the type in promoting good sedimentation is clearly evident.

Tiny globules of oil generally accompany these fine gas bubbles to the surface. It is this iridescent coloring of oil on water which constitutes the only visible effects of this action. One-half of the tank was baffled during the last three months of operation, the oil being caught just before passing out over the outlet weirs. As a result the effluent from this half of the tank was greatly improved, although the appearance of the baffled half of the tank was accordingly sacrificed by the collection of the thin layer of scum retained upon it. It could not be proved that this "pin-point" boiling decreased the efficiency of sedimentation.

Sludge Experience

The 80-per cent sludge produced during 1920 was a fairly stiff semi-solid and dried much less rapidly on the beds than the 94 per cent sludge of 1919.

The original Dortmund tank went into operation June 30, 1919. On July 25 the first sludge was drawn from the tank and delivered to a secondary tank. Its tarry odor, brownish-black color and curdy consistency, as we have since come to know them, were at once evident. The moisture was 94 per cent. On Aug. 7 about 300 gal. of this sludge were allowed to run directly to the sludge beds from the primary tank. Eighteen days later this same sludge was removed from the beds in pieces—a matted, porous, fibrous cake. After a few days further drying this sludge was burned in piles on the dike surrounding the beds. A fluffy, reddish ash was left behind. This performance was duplicated many times during the summer and early fall with the same favorable results. Contrary to the behavior of most sludges, which fissure vertically in drying, this sludge seemed to dry in layers, separating laterally. Visitors at the station often compare the appearance of this sludge to that of heavy brown paper.

This very unusual behavoir of a practically raw sewage sludge drying on sand beds under all sorts of weather conditions, without nuisance or even appreciable odor, caused us to dispense entirely with secondary tank digestion during 1920. But two of the sludge digestion tanks were ever used for this purpose. They were operated on the fill-and-draw principle. Since there was so little to be gained by the use of secondary tanks they were abandoned with the idea that we would operate the station under the hardest conceivable conditions by drying a primary tank sludge on the beds and kick up a nuisance if possible, but we failed.

Since we had precisely the same sludge experience during 1920 that we had in 1919, and one that differs so radically from that in other cities, we have attempted to explain the mystery by a combination of circumstances. (1) We have a sewage that is comparatively dilute, amounting to more than twice the average water consumption. Thus the

medium is provided by which many of the finely divided organic solids can be carried off in the effluent. (2) The presence of tarry oils, always noticed in the sludge, are discharged in alleged small amounts by the local gas works. The antiseptic action of these light oils has long been recognized. (3) A large proportion of the sludge is made up of pulpy rag and strawboard wastes, discharged into the Prescott sewer by a local paper mill. This material is practically inert and forms the fibrous mat which facilitates the drying and burning of the sludge. Samples of this dry sludge had a heat value of 7,000 B.t.u.

In conclusion, it must be admitted that from the Grand Rapids standpoint, with a sludge promising so little difficulty to handle, the high concentration is very desirable. Especially where an almost unlimited space for sludge beds can be provided. There are 130 acres in the tract selected for the site of the permanent plant—fairly well isolated from the city. But there are several points still to be settled before final recommendations can be made. While much depends on the results of the 1921 experiments, the Dorr clarifier in my opinion has great possibilities. Compared with the Dortmund tank it has given practically the same sedimentation efficiency and delivered a much more concentrated sludge for at least six months in the year with but half the excavation required for the Dortmund. Against these advantages are the greater depreciation in Dorr super-structure and mechanism and the greater expert attention required for the successful operation of a plant of this type.

The city has expended $63,000 to date for sewage disposal purposes, of which $30,000 has been applied toward the purchase of land for the permanent site, $13,000 is the outlay for building and equipping the sewage testing station, and the balance covers operating and other expense incidental to sewage disposal studies since April, 1917.

Hoad & Decker, consulting engineers, Ann Arbor, were the designers of the original Dortmund tank and testing station. The Dorr Co. organization has taken an active interest and co-operated greatly with the city in conducting its experiments during the past six months. All samples were analyzed at the laboratory of the water filtration plant under Walter A. Sperry, chief chemist.

Tie Records From Test Tracks

From report of Committee on Ties, American Railway Engineering Association

IT IS highly important to know the life and comparative value of different kinds of ties in the same locality and in localities having different climatic and traffic conditions. Without reliable information of this kind, it is not possible to purchase or treat ties economically or distribute them wisely. The method of test sections is the best for obtaining the necessary data, but methods of installing the sections and of collecting and reporting the data on different railroads are not uniform, although the work of the Forest Products Laboratory has tended toward uniform methods of reporting. Some larger roads have installed only one or two test sections. Others have installed at least one on each roadmaster's district. Some have put in only a few ties of each kind and few kinds; others have placed not less than a hundred of each kind and many different kinds.

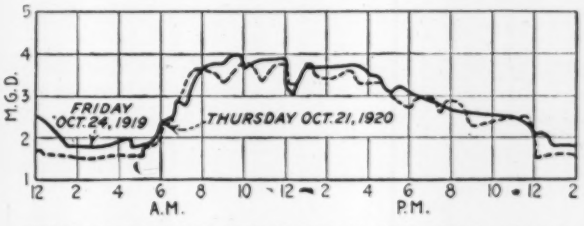
The principal criticism of the test section method of obtaining data on the life of ties has been that it often gave abnormal results, due probably to the fact that the ties are in most cases selected, the maintenance is above the standard and the renewals are watched with unusual care. The chief object of the tests is to secure comparative data and the test sections usually give this comparison, but the tests might be made more nearly representative if care were taken to keep the conditions as near as possible to average actual practice. Of forty railroads only five submitted data to show that a systematic record of test sections had been kept; namely, the Chicago, Burlington & Quincy, the Great Northern, the Baltimore & Ohio, the Pennsylvania and the Northern Pacific. Several other roads are keeping a more or less complete and comprehensive record of this kind.

Water-Waste Prevention Methods and Results in Superior

A Fully Metered City Supplied Through Master Meter Runs Down Eight Million Gallons Per Month in Service Leaks

BY W. C. LOUNSBURY AND ALLEN W. FOWLER
General Manager and Assistant of the Superior Water, Light & Power Co.

AS WATER is pumped twice in order to supply an iron-free well water to the water-works system of Superior, Wis., the local company has utilized all of the precautions to insure as high a ratio as possible of water paid for to that pumped. For many years the city has been entirely metered except for a few large fire services and a few consumers who do not have sewer or waste pipe connections. Such a widespread use of meters is an effective check upon voluntary waste.



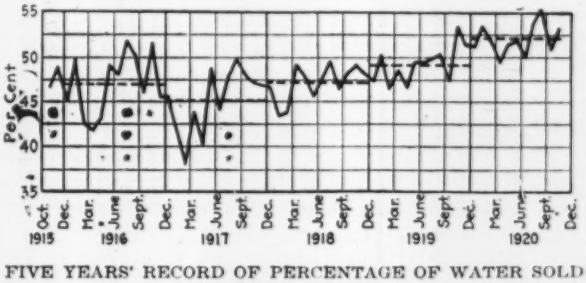
TYPICAL HOURLY CONSUMPTION ONE YEAR APART SHOWING RESULTS OF WASTE SURVEY

The ratio of water sold to that pumped, as shown on the accompanying chart, takes into account only water paid for—not that supplied free to public buildings and schools although such water is metered.

In Superior water is used or wasted in the following ways:

1. Sold to consumers through meters.
2. Unregistered water passing through consumers' meters.
3. Sold to flat rate consumers.
4. By public buildings, including fire halls, city hall, municipal jail and school houses.
5. For fire department purposes.
6. For street sprinkling and washing.
7. For drinking fountains from May to November.
8. For sewer flushing.
9. For park fountains and sprinkling.
10. For flooding public ice rinks.
11. For company uses in connection with the pumping station and filter plant.
12. By loss from known leaks pending repair.
13. By pipe and service leakage.

To account for the water pumped estimates must be made for each of these uses and it is not difficult to account for all of the water lost in any system by estimating these liberally enough, but the writers believe


Per Cent
55
50
45
40
35
Oct. Dec. Mar. June Sept. Dec. Mar. June Sept. Dec. Mar. June Sept. Dec. Mar. June Sept. Dec. Mar. June Sept. Dec.
1915 1916 1917 1918 1919 1920

FIVE YEARS' RECORD OF PERCENTAGE OF WATER SOLD TO THAT PUMPED

the large personal factor which enters into such estimates makes many reported statistics of water accounted for entirely unreliable and our own estimates repeatedly made to try to account for the entire pumpage in Superior have always seemed unsatisfactory. Nevertheless, studies made along these lines led to the belief that entirely too much water was getting away.

A careful survey was made of the water used in many of the ways enumerated above and meters were installed on all services entering public buildings. Particularly was the night rate studied and an accumulation of data indicated that the minimum rate of consumption was higher than is warranted in a city like Superior.

All of the construction work in the distribution system has been done under the direct supervision of one man who has had charge of this work for a great many years and who was a workman on the mains when the original installations were made 31 years ago. Moreover, practically all of the joints have been calked by two employees equally long in the service. Knowing the workmanship of these men and appreciating the character of the soil, which is uniformly a dense clay, it did not seem that there could be much water getting away because of joint leakage. Nevertheless it was decided to make a survey of our distribution system by the well known hose-and-meter method. The company undertook to make this survey with its own men and for three years the writers have annually made such a survey. This work was done at night between 1 and 5 a.m.

Tests Made by Districts

The city was first divided into eleven districts, which were tested separately on consecutive nights. The practice was to isolate a district by closing the control gates and then to observe the pressures with a recording gage, supplying the district by fire hose so arranged as to pass the water through a carefully calibrated 3 x 1-in. venturi meter. The test of each district covered the consumption of that district for about one hour, the recording gage recording the changes in pressure during that time. An allowance for reduction of pressure was made in computing the normal flow to the district. During the period that these tests were being made careful records were kept of the pumpage from the station both by means of a master meter and by pump revolutions. After the tests of the eleven districts had been completed each year some of those showing the largest consumptions were further subdivided and attempts made to locate the leaks. No large leaks or illicit uses of water were found by this method but it was demonstrated that the leakage was widely distributed.

For reasons before given it did not seem probable that this widely distributed leakage was from defective mains. Since all service pipes to the curb cocks are of extra strength lead it did not seem likely that the leakage would be found in these connections, but inasmuch as the connections from the curb to the consumers have been the work of plumbers and galvanized-iron pipe is invariably used it was surmised that the customers' services might be defective.

An endeavor was made to locate small leaks on customers' services by supplying a small section of three to six blocks through the hose and meter and then shutting off the customers' services in a single block, observing carefully the changes in flow at the meter. The services were then opened and those in another block similarly tested. This method enabled us to detect 27 small leaks, aggregating 58 gal. per minute, on six miles of mains in the oldest part of the city. This work was, however, laborious, disagreeable and expensive on account of its having to be carried on at night using a crew of four men and a truck.

To overcome these objections W. H. Winslow, vice-president of the company, suggested that a special apparatus be devised, consisting of a small force pump with its outlet carrying a few feet of garden hose. The pump is mounted on a small stand and is arranged to draw water from a calibrated pail. With this apparatus one can determine whether or not a service pipe leaks, and if it does at what rate. The house shut-off valve is closed and the meter disconnected. The outlet hose of

FORCE PUMP WITH HOSE AND GAGE FOR TESTING CUSTOMERS' SERVICES

the pump is then attached to the outside service connection. The shut off, usually a stop-and-waste cock, is opened again and the city water pressure shows on the gage. If there is an excessive leak the gage indicates it at once. A second inspector is stationed at the curb and while the pump is being connected he is opening the curb box and placing a curb cock key in position. Upon a signal he closes the curb cock. The inside inspector then attempts to pump water into the service pipe. If the pipe is tight no water can be pumped into it. If it is leaking, the inspector has to pump more or less rapidly to maintain the pressure. By timing the fall of the water level in a calibrated pail with a stop watch the rate of leakage is easily determined. If a service leaks so badly the pressure cannot be held up to normal with the pump a correction must be made or the result will show a smaller leakage than exists. In our work such a correction has not been made.

Since June 1, 1920, services numbering 4,295 out

of a total of 6,767 now in use have been tested with this apparatus, and 205 underground leaks have been found which would not have been discovered by ordinary inspection, and which were permitting a leakage of more than 8,000,000 gal. per month.

Listening on the pipe either directly or with the use of any of the well-known instruments for this purpose might have indicated a leak but would not prove its existence on the service pipe belonging to the consumer. The pump apparatus leaves little for the judgment and actually measures the leak.

SUMMARY OF LEAKS FOUND IN 1920

Month	No. of Services Tested	Underground Leaks	Leak in Gal. per Month	Payroll Cost of Inspectors
June	996	38	2,093,000	$169 54
July	850	32	1,274,000	175 00
August	725	40	1,641,000	175 00
September	552	34	1,447,200	151 00
October	595	30	896,400	176 00
November	577	31	799,200	175 00
Totals	4,295	205	8,150,800	$1,021 54

These leaks have all been repaired by the owners of the property, as the company does no service work on the consumer side of the curb. Inasmuch as the fuel item alone makes a cost of 1¼c. per thousand gallons pumped it is evident that the annual saving may run considerably over $1,200 with a total investment of less than this amount.

The ratio of water sold to water pumped has increased during this period and the monthly pumpage has decreased an amount approximately equal to the saving indicated.

The apparatus has also been used to demonstrate leaks in toilets and in house connections, particularly where they pass below the basement floor. When used in such a way the meter is removed and the pipe capped or the stop and waste plugged. Water is then pumped back into the house through a connection with an open faucet or from the meter loop. Records of such tests have not been kept for they were apart from the purpose of the study.

A Large Rain Gage and Heavy Rainfall

By B. F. Rush
Assistant Engineer, U. S. Geological Survey, Honolulu, T. H.

A RAIN gage with a diameter of 27 in., a height of 5 ft., and a capacity of 900 in. of rainfall sits lonesomely on top of Waialeale, one of the highest peaks of the mountains which traverse the island of Kauai, in the Hawaiian Islands. The ratio of the area of the small opening at the top of the main body of the container is 1 to 20.

Waialeale has an elevation of 5,080 ft. At the location of the gage the mountain range drops off to an abrupt descent of from 2,000 to 3,000 ft. to the north. The slope to the south is gentle.

The trade winds coming from a northerly direction strike the cooler surface of the mountains and here unload an enormous supply of their saturated vapor in the form of rain. The precipitation here is reported to be, if not the greatest, at least one of the heaviest in the world. The measured rainfall from Jan. 8, 1920, to Feb. 3, 1921, was 590 in., or an average of about 1½ in. per day. The gage is visited yearly by a member of the U. S. Geological Survey.

A hose was used to siphon the water from the container, for when this can is full there is danger of denting its sides if it emptied in the ordinary way by tipping it over.

The Georges Creek Accident and Ruggedness in Bridges

Collision Resistance Increased by Subpaneling and Heavy Gusset Plates—Material and Workmanship

By A. W. Buel
Consulting Engineer, New York City

THE article in *Engineering News-Record* of Jan. 20, p. 100, describing and illustrating the train wreck on the Georges Creek Junction bridge suggests the question, what features of the construction account for the remarkable reserve strength that enabled this bridge not only to continue to stand but even to carry trains on one track after the wreck was cleared? As the bridge was designed and fabricated under the writer's supervision he is glad to contribute remarks on these items to complete the record and assist in bringing to the attention of bridge designers any lessons the accident holds.

As described, the bridge consisted of two double-track through spans, each 150 ft. long. The trusses were of the Baltimore form, with five main panels or ten subpanels of 15 ft. each. They differ from the double Warren system with vertical posts used by the late George H. Thomson of the New York Central for many years, by lacking the upper half of one diagonal, which change reduces ambiguity and saves weight. The happenings in the wreck do not indicate that the Thomson form of truss would have behaved any better.

Subdivided Web and Short Panels

Subpaneled trusses have been criticised severely in recent years for two different reasons. The single-intersection or Pratt truss has been claimed superior because it is lighter (which is true only when the subpanels are relatively short). Other things being equal, the engineer naturally prefers a design with fewest members; but the Georges Creek accident goes far toward showing that other things are not all equal. In other words, the greater number of members, which is often objected to, proved to be a distinct element of value in this accident, by increasing the resistance of the truss webbing to destruction by the wrecked cars.

Second, measurements of stresses in bridges have disclosed the presence of important secondary stresses in riveted bridges, and have shown that subpaneled trusses are apt to have larger secondaries than trusses without subpaneling. This criticism has led to a distinct loss of favor of subpaneled trusses in recent years. But it may very properly be claimed that the sections of members required in a 150-ft. span do not involve large secondary stresses until the overload on the bridge approaches 50 per cent. "It is not used any more" is the way the subpaneled truss is nowadays disposed of. It seems that modern structural design is putting some pretty good old practices on the shelf.

In the writer's opinion it is largely the short panels of the Georges Creek Junction bridge that account for its ruggedness. The short panel length, of course, is closely related to the use of a subdivided web system. With 15-ft. panels a coal car is never carried by less than three floorbeams, and two-thirds of the time its weight is distributed over four, of which a single one would be capable of holding it up. This fact is adequate to account for the strength of the floor after complete rupture of several hangers.

Gusset-plate strength, however, was also a probable

factor in the matter. All the gusset plates of this bridge, at subpanel as well as main points, are $\frac{11}{16}$-in. thick, so fixed as to make the bearing value equal to the double shear value of the rivets. Heavy gusset plates may possibly tend to increase secondary stresses, but their use in this structure unquestionably contributed part of its reserve strength.

The subpanel diagonals provide effective collision struts, not only for the end posts but also for the main diagonals, cutting in half their unsupported lengths about axes perpendicular to the plane of the truss. At the same time the small number of main web members and their relatively massive proportions correspond to those that would obtain in a long-panel design. The addition of the subpanel diagonals and hangers is largely offset by the reduced weight of the stringers. The subpanel form of truss combines advantages of long and short panels, and the accident under discussion tends to show that it also has collision-resisting properties peculiar to itself.

Not every subpanel truss would behave in a similar manner to this one unless its details and connections insured the integrity of the structure as a whole. But even with all the care possible our knowledge of many things is so limited, particularly as to the destructive forces of accidental collisions and derailments, that our designs are far from perfect, and in fact such forces are not specifically taken account of in designing.

Possibly an intensive study of accidents such as this one may eventually lead to some conclusions that will enable designers to provide for a certain measure of collision resistance, within reasonable cost.

In the meanwhile it is gratifying to find that a bridge designed to carry only ordinary loads can show so much resistance to collision forces.

Planing and Reaming

Rather unusual toughness was displayed by the material, as indicated by the remarkable amount of bending and twisting and the fewness of fractures. This satisfactory showing is probably due more to fabrication than to inherent quality of the steel, since the latter was ordinary open-hearth structural steel except that the range of tensile strength specified was somewhat increased so that the mills could roll the steel without finishing at either too high or too low temperature. The workmanship, however, was unusual in that subpunching and reaming, and general planing of sheared edges, were called for. Further, by penalizing material $\frac{3}{4}$ in. thick and over through requiring that it be drilled from the solid, the specifications limited the thickness to $1\frac{1}{16}$ in.; this statement applies to a total of over 30,000 tons of bridges, and the only exception was the turntable of a double-track swing span, where thicker material had to be used and the holes were drilled. The design and fabrication were strictly in accordance with the writer's published specifications of 1906, with one or two minor revisions made in 1910.

Distinct importance attaches to one point that was the subject of discussion at the time the bridge was designed. The railroad line in question makes through connection with a railroad having extremely dense and heavy freight traffic, and on the latter line, because of a train wreck that had destroyed a bridge some years before, the practice of equipping bridges with fender or skid girders had been adopted. Because of this fact the question came up whether skid girders should be put on the Georges Creek Junction bridge, especially because it is located on a 1.62 per cent grade descending east, with the west approach on a 2 deg. 16 min. curve. The writer reported to the chief engineer that such provision would be in the nature of casualty insurance, and submitted an estimate of the cost of the skid girders and of the necessary increase in bridge weight to carry them. It was thereupon decided to omit the skid girders.

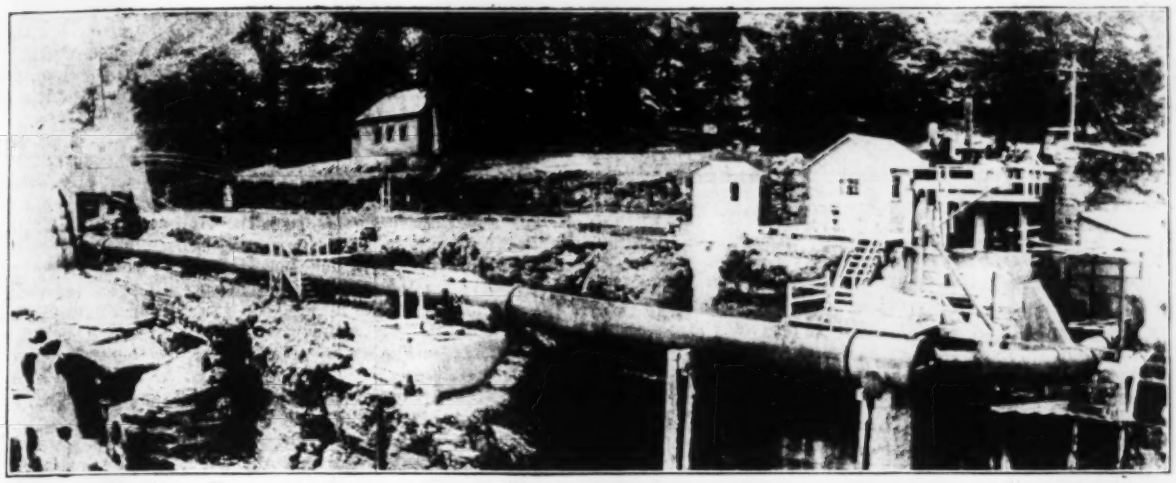
Should Skid Girders Be Used?

Compounded to the time of the accident, the extra cost would have amounted to about $8,000. The bridge stayed up even without the skid girders, but it is nevertheless of interest to consider whether the skid girders might not have saved a large item in the cost of repairs. Will not the engineers who had charge of the repair work give us some information on its cost to assist in deciding for or against them in future bridge design?

Referring again to the reserve strength realized through short paneling and subdivided webbing, mention may be made of the writer's experience with two bridges in Central America. One, in Costa Rica, whose truss form was similar to that of the Georges Creek bridge, had first one abutment and later (after its repair) the other partly washed out in a heavy flood. For a time it was supported on three corners only, but in this condition it nevertheless carried 10-ton cars and showed no distortion, either general or local. The Las Vacas viaduct in Guatemala, 230 ft. high, described in *The Engineering Record* Dec. 8, 1906, p. 638, and Jan. 26, Feb. 2 and Sept. 14, 1907, pp. 104, 118 and 297, went through the 1917 earthquakes with practically no damage. Some anchor bolts were sheared and some trusses and towers displaced a few inches, but repairs were made and the line reopened in about 6 hr. The basic principles of design applied to this structure were identically the same as used in the case of the Georges Creek Junction bridge.

Efficiencies of Residence Water Systems

TESTS made on several displacement-pump compression-tank farm residence water-supply systems of 100 to 200 gal. per hour capacity showed over-all efficiencies of from 15 to 25 per cent under normal operating conditions, with 17.5 per cent as a fair average. These results were given by G. C. Blalock, assistant professor of electrical engineering, Purdue University, in a recent paper before the Indiana Engineering Society. The efficiency increased with the pressure but the pump is likely to operate at a reduced pressure for a large percentage of its total operating time. Motor efficiencies varied from 40 to 60 per cent, with 50 per cent as a fair average. Thus the pump efficiency in this type and size of plant may be expected to average about 35 per cent. These efficiencies result in a pumping duty of 2.1 to 1.25 kw.-hr. per 1,000 gal. per 1,000-ft. head, with 1.8 as a fair average. Considering the capacities of these units this figure compares favorably, Mr. Blalock stated, with the average for the smaller city pumping units over the state age for the smaller city pumping units over the State of Indiana. The trend of present-day isolated plants, according to Mr. Blalock, is away from the elevated storage tank formerly used with hand, windmill or power pumps toward the hydro-pneumatic tank which is the purely pneumatic system in which the tank is used for the storage of compressed air only.



Testing Turbine Efficiency by Pressure Measurement

Gibson Method and Apparatus Investigated Experimentally and Used in Practice in Determination of Discharge of Water Wheels in New Niagara Falls Plant

By Norman R. Gibson
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Abstract of a paper presented at the Hydro-electric Symposium held at Philadelphia, Jan. 28, 1921, under the auspices of the Philadelphia Engineers' Club, and the Philadelphia sections of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, and American Society of Civil Engineers.

IT is the purpose of this paper to describe the efficiency tests of three large new 37,500 hp. units in Station No. 3, Extension of the Niagara Falls Power Co. and to refer particularly to the application of the writer's new invention for measuring the flow of water in penstocks. This method seemed to offer many advantages, particularly in the case of very large units supplied with water through closed conduits. It is the outcome of studies of the changes of pressure in penstocks caused by the gradual closing of turbine gates which appeared in the form of a paper published by the American Society of Civil Engineers in April, 1919. This paper will not contain a mathematical analysis of the method nor a detailed description of the apparatus employed. Patents have been applied for on the invention.

The method makes use of two well known principles, the first being Newton's second law of motion, sometimes referred to as the equation of impulse and momentum, and the second being a corollary of the first, namely, the relation between change of pressure and change of velocity of a column of water expressed in terms of the velocity of the pressure wave. The application of these two principles makes it possible to determine the mean velocity of a column of water in a penstock by recording the changes of pressure at a point in the pipe line when the flow of water therein is gradually brought to rest by closing a valve or the turbine gates. The mean change of pressure recorded is a precise measure of the velocity destroyed.

The apparatus comprises a new combination of simple elemental parts in which the pressure element is a U-tube containing mercury, the motion of which can be made to correspond in any desired ratio to the change of pressure in the penstock. It provides illumination and records photographically to exact full scale the motion of the top surface of the mercury in the tube and combines in the record the oscillations of a seconds pendulum. The resulting diagram shows to exact scale a complete record of pressure changes and time.

The first experimental equipment comprised a head-water tank feeding a 3 in. wrought-iron pipe 420 ft. long, near the lower end of which was placed a 3-in. globe valve. The flow through this pipe was made to discharge into a measuring tank about 5 ft. wide by 10 ft. long by 4 ft. high. By maintaining a constant level in the head tank and opening the globe valve various amounts it was possible to produce a steady flow in the 3-in. pipe at various velocities up to about 4 ft. per sec. The discharge was measured in the measuring tank and then the globe valve was closed by hand. The pressure recording apparatus was attached to the 3-in. pipe just upstream from the globe valve and during the closing of the latter the apparatus recorded the changes of pressure in the pipe. The results of these experiments were remarkably satisfactory considering the nature of the equipment and it was found that the variation of measurements by the new method from the volumetric measurements was seldom greater than ½ per cent.

Following this work a new set of apparatus was built and trials were made not only with the 3-in. experimental pipe but also on the 9-ft. penstock of Unit No. 2, in Station No. 3, of the Niagara Falls plant. Efficiency curves obtained by the new method were compared with curves made by pitot tube some years previously on a similar unit. The two curves have the same characteristics, the new one being just a little lower than the old one, which it was considered reasonable to expect in view of the age of the unit.

With this evidence in hand the matter was brought to the attention of the United States Division Engineer at Buffalo, who had charge of the regulation of the use of water from the Niagara River, and upon request the company was advised that the new method might be used for determining the relation between power and discharge of the new units then being installed if satisfactory proof were given as to the accuracy of the new method or the coefficient that should be used, if any. It was desired to use the new method rather than one of the older and well known methods mainly because the tests could be carried out without serious or prolonged interruption of the supply of power from the unit being tested. It requires a two-minute shutdown for each measurement and the measurements may be repeated about once every ten or fifteen minutes. A complete set of measurements at each tenth of gate opening from half to full gate may be made in less than two hours and during that time the unit would be out of commercial service only about 15 minutes. There were

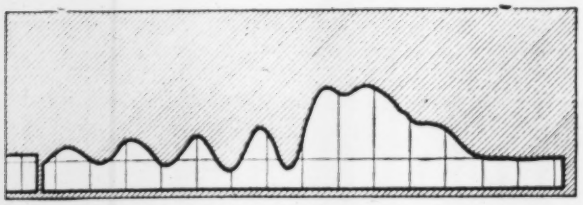


FIG. 1. TYPICAL PRESSURE-TIME DIAGRAM, STEEL PIPE 48-IN. DIAMETER, 142.63 FT. LONG. CLOSURE BY BUTTERFLY VALVE

two other reasons that may be mentioned, one that the trouble and expense of the tests would be much less than by any other method, and the other that it was believed the new method was very accurate.

The reason for the accuracy of the new method will be appreciated by a reference to the fact that a small change in velocity can be made to produce a relatively large change of pressure. The mean change of pressure corresponding to a change of velocity can be made from 5 to 20 times the velocity head or even greater if there were any advantage in doing so. In the pitot tube the velocity head only is observed or at best by differential methods only some small multiple of it. In the new method a record is made with great precision of a quantity that is many times greater than the velocity head. In other words the quantity observed and recorded is many times greater than but is proportional to the quantity it is desired to know. It is true, of course, that this change of pressure takes place in a comparatively short time and the element of time must be considered. It is comparatively easy, however, to measure time very accurately. It so happens, however, than in the new method it is not necessary to measure time directly at all, but only the product of pressure and time which may be done very accurately indeed.

In order to obtain satisfactory proof of the accuracy of the new method of measurement as required by the authorities in charge of the regulation of the use of water arrangements were made with Dean E. E. Haskell of the College of Civil Engineering at Cornell University to have a thorough test made by comparison with volumetric measurements at the laboratory of the University. There is probably no other place where hydraulic experiments of this kind can be made so satisfactorily as at Cornell University.

The general arrangement of the equipment used at the laboratory may be noted from the accompanying photograph. In the background is the dam which impounds water in a comparatively large reservoir and at the south end of the dam is the intake to a 48-in. steel conduit. The intake comprises a submerged orifice protected by steel screen bars and a gate well into which the water flows before it enters the pipe. A 48-in. rising stem hand operated gate valve controls the flow into the pipe.

The 48-in. pipe extends for a distance of 198.37 ft. to a dead end, but about 4 ft. from the end a 30 in. cast-iron pipe branches off at an angle of about 45 deg. and after passing two bends discharges into the weir channel inside the laboratory building. In the 30 in. branch two valves at the points were placed, one a 26 in. butterfly valve with reducers and the other a 30 in. hand operated rising stem gate valve.

The weir channel is about 35 ft. long, 6 ft. wide and 7½ ft. deep below the channel walls. In it are placed heavy baffle boards for stilling the discharge from the 30 in. pipe and at high flows a timber raft is used in addition for the same purpose.

After discharging over the weir the water may be wasted or may be directed into an accurately calibrated steel standpipe which is 6 ft. in diameter and 60 ft. high. The quantity of water is measured volumetrically in this tank. The elevation of the water surface in it is determined by means

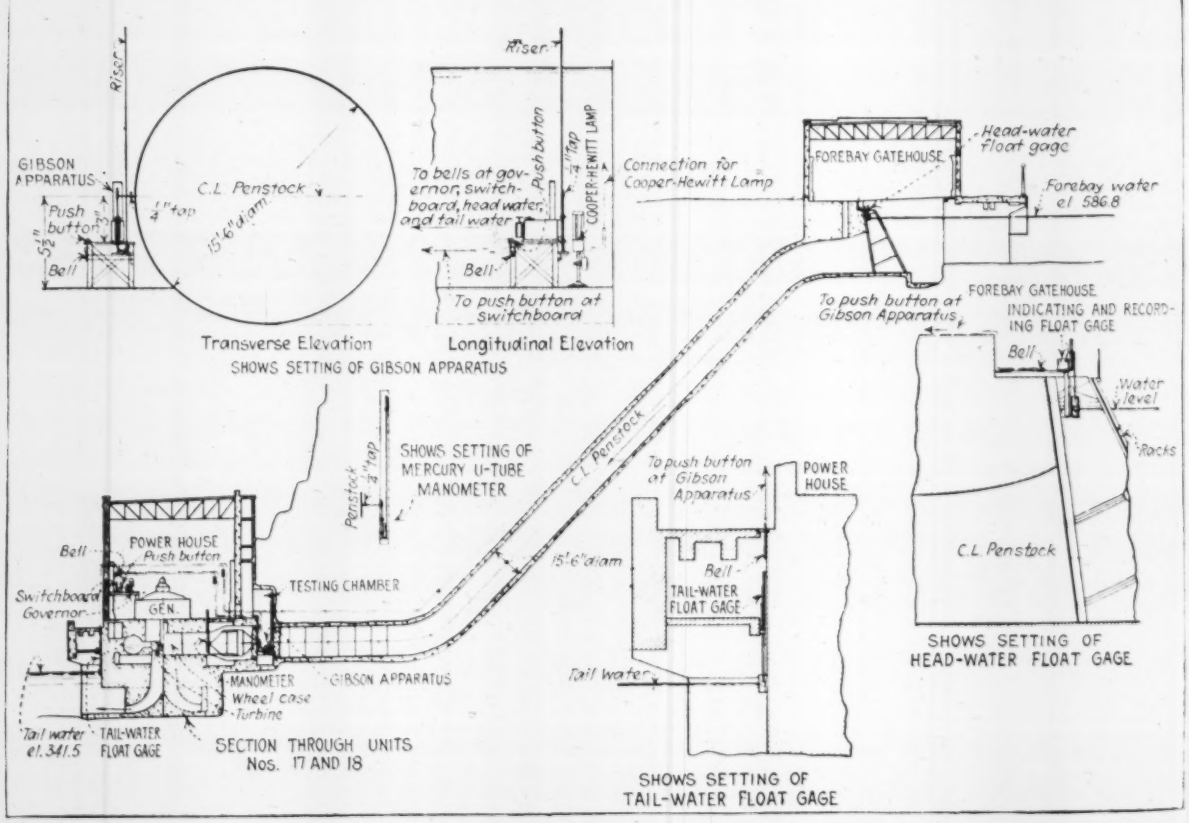


FIG. 2. SETTING OF TESTING APPARATUS AT NIAGARA PLANT

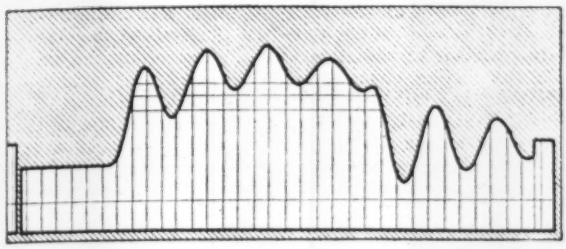


FIG. 3. TYPICAL PRESSURE-TIME DIAGRAM, FUNNEL OF PENSTOCK AT NIAGARA, 15 FT. 6⅛ IN. DIAMETER, 371.5 FT. LONG. CLOSURE OF TURBINE GATES

of a counter-weighted float gage, readings being taken by observations of a steel tape which passes over a pulley. The water is directed into the standpipe by means of a counterweighted diverter which quickly cuts through the nappe of the water passing over the weir. As the diverter passes through the nappe, electric contacts in circuit with a chronograph are closed. The contacts are adjusted to close when the edge of the diverter is at the middle of the nappe.

For the tests the Gibson apparatus was placed on the concrete pedestal about the middle of the view and connected to a piezometer opening tapped into the wall of the pipe at a point 142.64 ft. from its mouth.

On account of the restricted entrance into the gate well at the intake and the consequent loss of head there was considerable surging in the gate well when the flow was shut off during a test. This variation in head water level had to be accounted for in determining the flow and the changes of level were obtained by recording the height of a float gage in the well. For convenience this was done by fitting up a second Gibson apparatus for the purpose which simply photographed the motion of an arm attached to the float gage, the photograph thus obtained being a record of the changes of level of the water in the gate well during a test.

The procedure during a test was as follows:

The lowest 30 in. gate valve was opened a fixed amount, partial opening being used for low flows and full opening for high flows. The discharge was then controlled by means of the upstream 26 in. butterfly valve which was gradually closed by hand.

During the closure the pressure-time diagram was made by means of the apparatus and a record of the surge in the gate well obtained as described above. A typical diagram is shown in Fig. 1.

After the shutdown the leakage through the butterfly valve was measured volumetrically and recorded. As the new method measures only the flow actually shut off, the comparison had to be made between the discharge as measured by that method and the net discharge measured by the volumetric method after deducting the leakage through the butterfly valve when closed.

A series of tests comprised three or four runs under as nearly as possible the same conditions of flow in the same way that check measurements might be made at any one gate opening in testing a turbine. The individual results and the average of all the results of any one series were then compared with the respective volumetric measurements and the average of the latter.

Six series, comprising in all 19 tests, were made under conditions approximating as nearly as could be had at the laboratory the conditions prevailing for efficiency tests at Niagara Falls. The table herewith shows the results of these tests, from which it is seen that the average of all measurements made by the Gibson method agree within less than 0.2 per cent with the average of all the volumetric measurements. The maximum variation of any one series is 0.8 per cent.

A careful analysis of these results has been made which indicates that part of even the slight variations between the volumetric measurements and measurements by the new method may be explained by a very slight unsteadiness of flow which is sufficient to account for some of the difference between the two measurements. This unsteadiness seems to be characteristic of all water flowing above the critical velocity, and while difficult to account for its was manifest in this case by the variations in the level of the water passing over the weir before it entered the measuring tank. The magnitude of the variations in gage height was an index of the magnitude of the variations in flow. It would be natural of course that variations in the measurements due to this cause would be both positive and negative and the mean of a series of results would not show differences of the same magnitude as might occasionally be found in any single measurement. The fact that the mean variation between the volumetric measurements and the measurements by the new method is only 0.2 per cent would indicate that while there might be a difference between the two methods of measurement for any one observation each methods might be as near perfect as the other because the quantity measured is slightly different in each case.

Having thus established by careful experiments the accuracy of the new method, the official efficiency tests of the three new units in Station No. 3 Extension at Niagara were made. The lower end of penstock tunnel is lined with steel plate and just before it connects with the Johnson valve, the lining forms a steel pipe passing through a testing chamber which has been made at the rear of the power house. Originally this testing chamber was designed for the use of pitot tubes, but it serves very well as a place in which the apparatus for recording the changes of pressure in the penstock may be set up. Fig. 2 shows the setting of the apparatus and other tests equipment with reference to the adjacent parts.

The general procedure for the test by the new method was as follows:

1. The physical dimensions of the interior of the penstock were measured from field data and available drawings.

2. Prior to all the tests that were made on any one unit, a leakage test was made to determine the quantity of water that leaked out through the turbine gates when closed. This is necessary in the new method because only the flow actually shut off is measured and whatever remains must be added to the total discharge. A leakage test of this kind is a very simple matter. The turbine gates are closed and pressure maintained in the regulating cylinders. The stop gates at the upper end of the penstock are then put in place and the water in the penstock gradually leaks out through the clearance spaces around the turbine gates. As the water leaks out the fall in pressure of the water in the

TABLE SHOWING COMPARISON OF VOLUMETRIC AND GIBSON MEASUREMENTS

(Record of Tests Made Under Approximately Niagara Conditions)

Test No.	Discharge c.f.s. Volumetric	Gibson	Percent Variation	Remarks
20-E-1	20.27	20.31	+0.2	Tube $K = 1.335$
20-E-2	20.42	20.52	+0.5	
20-E-3	20.45	20.65	+0.9	
	20.38	20.48	+0.5	Mean of series
30-A-1	30.38	30.51	+0.4	
30-A-2	30.63	.....	.....	Poor diagram (not completed
30-A-3	30.69	31.15	+1.5	
	30.57	30.82	+0.8	Mean of series
40-A-1	42.24	42.17	—0.2	
40-A-2	41.94	42.28	+0.8	
40-A-3	42.22	42.09	—0.3	
40-A-4	.....	41.96	.....	Volumetric not taken
	42.13	42.12	0.0	Mean of series
40-C-1	40.36	40.41	+0.1	
40-C-2	40.36	40.90	+1.3	
40-C-3	40.98	40.88	—0.2	
	40.57	40.73	+0.4	Mean of series
50-A-1	46.82	.....	.....	Film fogged, diagram invisible
50-A-2	46.95	46.60	—0.7	
50-A-?	46.98	46.60	—0.8	
	46.92	46.60	—0.7	Mean of series
50-C-1	50.30	49.95	—0.7	
50-C-2	50.66	51.47	+1.6	
50-C-3	50.93	51.15	+0.4	
	50.63	50.85	—0.4	Mean of series
Total of means	231.20	231.60	—0.2	Mean variation of all tests

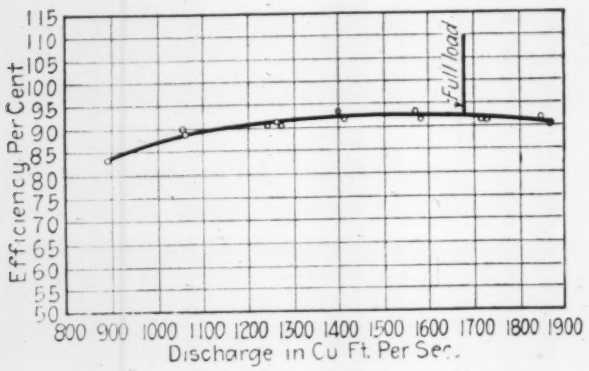


FIG. 4. EFFICIENCY-DISCHARGE CURVE OF UNIT NO. 16, NIAGARA

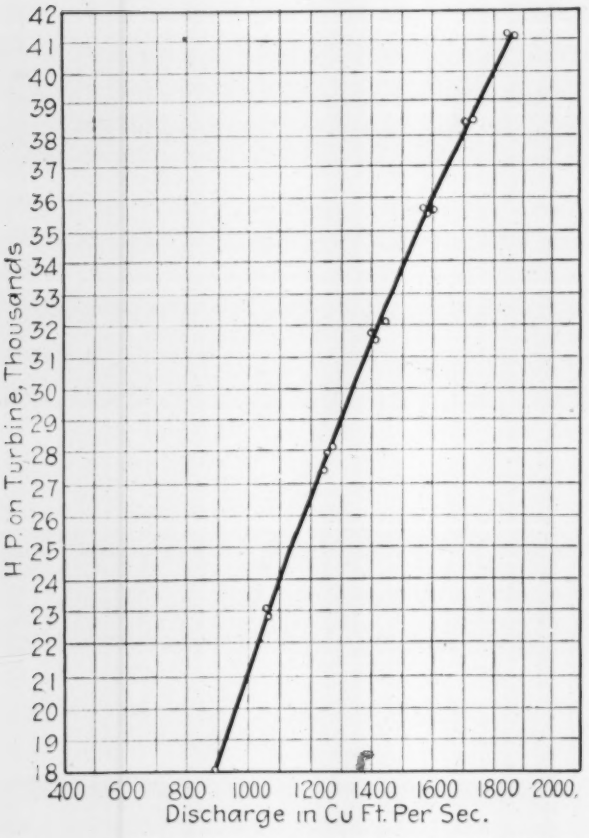


FIG. 5. POWER-DISCHARGE CURVE UNIT, 16, NIAGARA

penstock is observed by means of an ordinary pressure gage and the time and amount of each observation recorded. Then a diagram is plotted which indicates the rate at which the water has leaked out. In some cases the leakage through the stop gates at the upper end of the penstock was considerable and in order to correct for this the Johnson valve which is very tight was closed and the rate of rise of pressure in the penstock recorded as the water leaking past the head gates filled it up. This determined the rate of leakage through the head gates which could be used in obtaining the correct leakage through the turbine gates.

3. Having completed this preliminary work, the apparatus was attached to a ¼-in. piezometer opening tapped into the wall of the penstock.

4. Headwater and tailwater float gages were placed in the forebay and tailrace for observing the elevation of headwater and tailwater during a test.

5. A system of electric signal bells was established, t control buttons being placed in the testing chamber ne the operator of the apparatus. When ready the assista in the testing chamber could signal to the observers a forebay and tailrace and to the governor operator.

6. For observing the net head on the turbine a U-tub mercury manometer was set up with a connection to th penstock just at entrance to the turbine casing. Tw observers recorded the elevation of the surfaces of th liquid in the two legs of the U-tube. The gage was cali brated by reference to the total static head when the wate was at rest.

7. Making the diagrams. The unit being tested wa synchronized with other units in the plant and allowed to run on steady load with the gates fixed for several minutes and then it was shut down at a given signal by operating the hand control pilot valve on the governor. A cord was wound around the stem of the valve and on a given signal the operator pulled the cord which spun the pilot valve wide open. The pressure fluid then flowed to the regulating cylinders which operate the gates and they were closed just as fast as the fluid could flow through the connecting pipes into the regulating cylinders. The connecting pipes can be throttled to reduce the speed of closing if necssary. On other units the pilot valve is opened by means of a hand wheel, but the effect is the same. The duration of closure was usually from about 8 to 18 seconds, depending upon the amount of gate opening.

Immediately preceding and during the closure of the gates and for a short time thereafter the apparatus recorded the changes of pressure in the penstock forming a diagram similar to that shown in Fig. 3. As the gates of the turbine closed, the load on the generator was transformed automatically to the other units operating in synchronism with it, sufficient capacity having been left available for that purpose and the unit under test being then driven as a meter at sychronous speed.

8. For two minutes prior to the shutdown the power output of the generator was determined by periodic readings of a calibrated indicating wattmeter attached to the generator leads through calibrated current and potential transformers. The power output of the turbine was obtained by using the efficiency of the generator which was determined by the Company's electrical engineers.

9. Periodic readings of headwater and tailwater gages were also made for the two-minute period prior to the shutdown and for a short time thereafter.

It required about two minutes to make a single measurement and measurements could be repeated about once every 10 or 15 minutes or at the rate of 4 or 5 to the hour. In this way a complete set of diagrams was obtained for each unit at various gate openings. On account of the ease with which diagrams can be made several were taken at each gate opening so as to obtain an average result, and in all from 16 to 18 diagrams were made for each unit.

After velocities had been calculated from the diagrams and discharges and effective heads computed, the usual power discharge and efficiency curves were prepared. (Figs. 4-5). From these will be noted the remarkable uniformity in the determination of the points along the power-discharge curves from which it may be concluded that the errors of observation, or so-called variable errors, are extremely small. The absence of any inherent or consistent error was demonstrated by the tests made at Cornell University.

In conclusion attention may be drawn to some of the advantages of the new method of measurement where it may be applied:

1. Remarkable accuracy in the determinations of the velocity of flow because small changes of velocity result in comparatively large changes in the pressure to be recorded.

2. Determinations of velocity may be made without serious or prolonged interruption of the commercial supply of power from the unit being tested.

3. Each determination of the velocity of flow may be made quickly in one operation; tedious methods involving tabulation of observed results are avoided.

4. The process is essentially simple and inexpensive. Special appurtenances in the pipe line are not required.

California Highway System Investigated by Federal Bureau

Comprehensive Report Classifies Condition of 1,262 Miles of 4-Inch Concrete Pavement—Failures on Adobe Sub-Base Studied

RESULTS of an investigation of the California state highway system by the U. S. Bureau of Public Roads, characterized by Thomas H. McDonald, chief of the bureau, as the most comprehensive study of the sort ever undertaken, have just been made public in a report, signed by Dr. L. I. Hewes, general inspector in the West, containing 58,000 words of text, 115 maps and diagrams, and 400 photographs. Dealing with both engineering and economic features the report is devoted in large part to a consideration of the adequacy under present conditions of traffic of the State's old standard 15-ft. concrete pavement 4 in. thick, with either plain top or ⅜-in. wearing surface of asphaltic oil and pebbles. The investigation discloses that the financial administration of the work has been "scrupulously honest," that the system has been well selected and laid out, but that the policy as to the use of the relatively thin and narrow concrete pavement slab was "distorted" by a desire to produce a large mileage with limited funds.

A feature of the report is the classification into six grades (A to F inclusive) of the present condition of 1,262 miles of the State's concrete pavement, showing that 12.5 per cent was in classes D, E and F and the remaining 87.5 per cent in classes A, B and C. It is pointed out that 70 per cent of the pavement in the three poorer classes was built on clay and adobe soil. Construction costs are found to be reasonable. Overhead and indirect charges of 19.2 per cent for maintenance (12.5 per cent for overhead alone), however, are found to be "rather excessive."

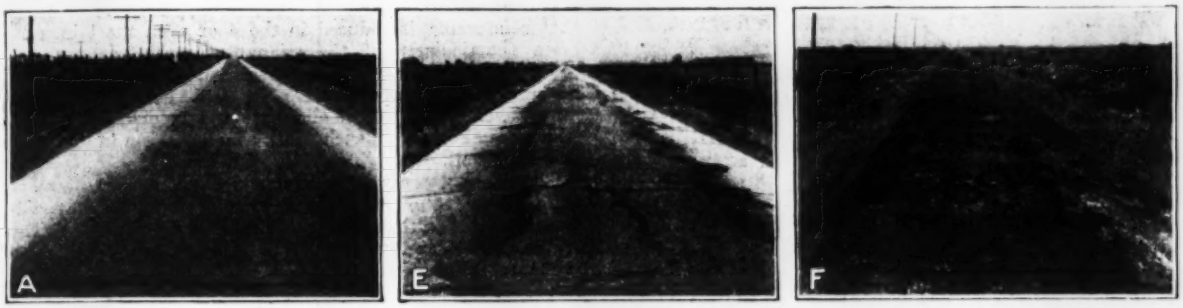
While conceding that the extension of a narrow paved mileage throughout the state did much to enlist public support for additional road bond issues, the report finds that the adopted paved width of 15 ft. is 3 ft. too narrow; that the "skin top" or oil surfacing is unjustified; that a minimum slab thickness of 6 in., reinforced, for the adobe soil subgrade conditions is needed; that reinforcement of so thin a slab as 4 or 5 in. has been ineffective on adverse soils; and that greater smoothness of surface finish to reduce impact is desirable.

Study of concrete cores from borings in the pavement indicates that there may be a slow, progressive deterioration or "fatigue" of the concrete itself in a thin slab subject to excessive flexure. However, there is nothing presented by the entire California study, the report concludes, to indicate that concrete is not a successful pavement. One of the clearest results, it is stated, is the need for better subgrade protection and further study of soil with respect to bearing power, capillarity and moisture content. A summary of the report's data, discussion and conclusions follow:

The statement of the condition of the funds on July 1, 1920, shows receipts, $42,007,330.07 and expenditures $41,790,884. The state laid 1,365 miles of concrete pavement of which 1,262 miles were classified as to condition.

Data

The state has expended from the motor vehicle fund for maintenance, improvements and reconstruction $5,780,551; the overhead and indirect charges on this work were approximately 19.2 per cent (overhead about 12.5 per cent). Maintenance of the typical 15-ft. by 4-in. concrete road costs 0.6c. per square yard per year and for concrete constructed with ⅜-in. oil top 0.9c. per square yard per year on an average.



TYPICAL EXAMPLES OF CONDITIONS OF SURFACE IN CLASSIFICATIONS A, E AND F

Basis of Classification—The classification of the existing condition of the concrete pavement for each one-tenth mile was in six classes, as follows:

(A) A pavement in which the plainly visible transverse cracks do not exceed the normal number expected of a pavement constructed without expansion joints, and which has no plainly visible longitudinal cracks.

(B) A pavement having more than the normal number of plainly visible transverse cracks or with some "crow-foot" cracks at the edges, or with both.

(C) A pavement similar to classes A and B and with one plainly visible longitudinal crack or with a considerable number of "crow-foot" cracks.

(D) A pavement so cracked transversely and longitudinally that numerous slabs are formed of less area than in class C but that do not average less than about 50 sq.ft.

(E) A pavement in which the plainly visible transverse and longitundinal cracks are so numerous that it is broken into slabs having areas less than about 50 sq.ft. but in which no general disintegration appears.

(F) A pavement badly broken and with disintegrated portions.

The classification result is given in Table I, which shows that 12.5 per cent of the pavement on July 1, 1920, was found to be in classes D, E and F and the remainder, or 87.5 per cent, in classes A, B and C.

On 800 miles of pavement 638 4½-in. diameter cores were drilled. The depth of concrete varied considerably, but in general ran greater than the specified 4-in. Measurements showed a surprisingly close average of 50 per cent coarse aggregate in both the 1:2:4 and 1:2½:5 concrete. The absorption showed an average of about 1½ per cent. The weight per cubic foot varied from 140 to 160 lb., with some marked deviation in a few instances. While the average compression test, when corrected for cylinders 9 in. high by 4½ in. in diameter averaged well above 3,000 lb., there is a slight decrease in compressive strength with the age of the concrete.

TABLE I.—SHOWING ALL CLASSIFIED CONCRETE PAVEMENT BUILT BY THE STATE (SURFACED AND UNSURFACED)

Year Built	1913		1914		1915		1916		1917		1918		1919		1920		Totals	
Class	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent	Miles	Per Cent
A	2 83	13 8	71 35	42 5	139 33	39 7	73 38	24 8	6 65	11 3	37 54	30 0	53 91	32 6	33 24	42 9	418 23	33 1
B	5 85	28 6	63 75	38 0	106 35	30 3	119 62	40 5	26 29	44 4	49 50	39 6	66 78	40 4	37 32	48 2	475 46	37 7
C	3 85	18 8	18 27	10 9	68 17	19 4	53 41	18 1	15 28	25 8	24 37	19 5	23 90	14 4	4 15	5 4	211 40	16 7
D	1 83	9 0	4 67	1 6	14 65	4 2	32 59	11 0	8 66	14 6	10 24	8 2	12 20	7 4	1 60	2 1	84 44	6 7
E	0 10	0 5	0 40	0 2	3 15	0 9	11 55	3 9	2 29	3 9	3 29	2 66	8 23	5 0	1 00	1 3	30 01	2 4
F	6 00	29 3	11 50	6 8	19 14	5 5	5 13	1 7	0 00	....	0 05	0 04	0 25	0 2	0 10	0 1	42 17	3 4
Totals	20 46	100	167 94	100	350 79	100	295 68	100	59 17	100	124 99	100	165 27	100	77 41	100	1,261 71	100
Per cent of total each year	1 7		13 3		27 8		23 4		4 7		9 9		13 1		6 1		100	

A classification of subgrade soils shows that approximately 70 per cent of the concrete pavement of classes D, E and F occurs on soils of clay and adobe.

Traffic Study—The principal economic study consisted of a state-wide traffic census for one equivalent 16-hour day at 103 stations. Traffic was counted from 6 a.m. to 10 p.m. and the results are presented in Table II. It is seen that for week days the total daily number of all vehicles averaged approximately 1,387, of which 2.7 per cent was horse-drawn traffic and 12.5 per cent truck traffic. The corresponding average Sunday traffic at 16 stations was 2,267 vehicles, of which horse-drawn traffic was only 0.9 per cent and truck traffic 4.4 per cent.

TABLE II.—AVERAGE 16-HOUR WEEK-DAY TRAFFIC AT 101 STATIONS AND 16-HOUR SUNDAY TRAFFIC AT 16 STATIONS

Type	Average Vehicles		Per Cent of Total Traffic		Per Cent of Total Traffic	
	Week day	Sunday	Week-day	Sunday	Week-day	Sunday
Light automobiles	472	833	34 10	36 8	.....	....
Heavy automobiles	674	1,282	48 50	56 6	.....	....
Passenger buses	31	29	2 20	1 3	.....	....
Trucks, Class 1	73	62	5 30	2 7	42 20	50 5
Trucks Class 2	41	18	3 00	0 8	23 70	14 6
Trucks Class 3	28	10	2 00	0 4	16 20	8 1
Trucks, Class 4	29	12	2 10	0 5	16 80	9 7
Horse-drawn traffic	32	21	2 70	0 9	.....	17 1
Extra-heavy traffic	2	.....	0 10	....	1 10	....
Total of all vehicles	1,387	2 267	100 00	100	100 00	100
Total of trucks, only	173	123	.....	....	.....	....

Class 1. Less than 1 ton with pneumatic and less than ½ ton with solid tires.
Class 2. One to 2½ tons with pneumatic tires and ½ to 1½ tons with solid tires.
Class 3. Three to 5 tons with pneumatic tires and 2 to 3 tons with solid tires.
Class 4. Five tons plus, with pneumatic tires and 3 tons plus with solid tires.

Discussion

Standard Design — The standard design adopted for surface was a concrete "base" of 4 in. with a ⅜-in. wearing surface of asphaltic oil and pebbles. The concrete mix was 1:2½:5 and the width was 15 ft., with 3-ft. earth shoulders.

Although the concrete surface was doubtless originally laid as a base, only approximately 43 per cent has been given the oiled surface. The average price in the earlier years for 4-in. 1:2½:5 concrete and including grading and structures of $1.14 per square yard was remarkably low. This price was equivalent to about $10,000 per mile of completed 15-ft. road and compared very favorably with the similar price of $1.21 per square yard for oiled macadam. Neither price includes either indirect changes or overhead. The corresponding average price for the 4-in., 1:2:4 concrete laid since 1917 has been $1.84, which is also low. The concrete pavement has probably produced a smoother and more satisfactory riding surface than any of the other types.

This concrete pavement is the thinnest that has been extensively laid in any State and would have been rejected as too thin in any State subject to winter frosts. It is in general 3 ft. too narrow. The original mix of 1:2½:5 was leaner than that extensively used in other States, and the present mix of 1:2:4 is not as rich as usual in several States, but it is believed to be adequate for the traffic. California was the pioneer State in adopting concrete as the standard pavement for the State highway system.

The ⅜-in. asphaltic oil wearing surface has cost about 8 to 9 cents per square yard; it is not believed that it serves a purpose commensurate with its cost.

The 4-in. plain concrete of lean mix has proved in places very durable. There are 580 (distributed) miles built prior to 1917 that are of classes A and B. Under adverse conditions, particularly of soil, it is, however, evident that a pavement of such thinness has a very low safety factor and is inadequate. Its use has now been abandoned and a minimum thickness of 5 in. of reinforced concrete required. The original construction produced considerable rough surfaced concrete which as traffic developed doubtless materially increased impact. On the narrow 15-ft. pavement loads passing each other necessarily traveled close to the edge. The "crow-foot" defects are doubtless due to such travel of trucks. There is little, if any, decisive evidence that reinforcing introduced in the 4 or even the 5-in. concrete (particularly of the triangular mesh variety) has proved effective on adverse soils or under combinations of adverse subgrade and traffic. Nor will the widening of a 4-in. pavement to 20 ft. eliminate the "crow-foot" cracks which are observed on such width concrete, even in instances on sandy soil.

The original concrete pavement design in short now has little or no factor of safety and under unfavorable conditions has not withstood the internal stresses produced by traffic flexure and variations in temperature and subsoil moisture. It is doubtful if such a safety factor can be introduced wtihout considerably increasing the mass of concrete. It appears that under adverse soil condition there is considerable flexure with traffic.

Some special treatment of adverse subgrade soils will be necessary. Capillary action and high moisture retentiveness and violent shrinkage must be met. The amount of admixture or the thickness of protective layers of noncapillary and supporting soils is not yet known. A flat subgrade might help, to a slight extent, to counteract such defects by eliminating some transverse tension due to normal pressure. The crown of 2¾-in. in the present 15-ft. standard design may well be reduced to 1¾ in. and with a flat subgrade and an added 1¾-in. maximum thickness there is an added factor against center longitudinal cracks.

The width of the main roads should be increased from the present width of 21 to 24 ft. to a width of from 24 to 30 ft., except in heavy cuts. The crowns could well be reduced to 1¾ in. even on a wider pavement.

Grade and Alignment — Many miles of the California highways lie on flat valley floors and have excellent alignment. Defects in grade and alignment are due largely to a too strict adherence to a standard. That standard is not invariably economical. There are numbers of 50 and 60-ft radii curves and grades of 7 per cent that might have been eliminated or reduced at slight additional cost.

Specifications — The specifications appear to have been rigidly enforced. The original lean concrete mix of 1:2½:5 should have been abandoned sooner and the permission of 6 per cent of the fine aggregate passing a 100 screen allows a possible excessive clay content. Use of alkaline or salt water should be prohibited. The originally required rough finish has been abandoned, but the finish now obtained can be improved. This rough finish was evidently for a pavement base but it shows through a ⅜-in. top and, where not covered, has doubtless tended to increase impact. The present requirement for concrete mixture of 1:2:4, if laid dry should produce a good pavement for traffic preponderately rubber tired, but it is remarked that several States use a richer mix. Reinforcement has not been required until 1920 but the present specifications for about 42 lb. of ½ and ⅜-in. steel rods in the center plane per 100 sq.ft. are excellent. The triangular mesh reinforcement used as Federal-Aid Project No. 1 was a failure, due possibly to improper

placement. In general the specifications for concrete have produced good quality and have permitted an economic use of local material with a minimum of failures.

Policy of Extension of Mileage — The total motor vehicle registration in 1920 is about six times that of 1912—and the total truck registration is approximately six times the 1915 figures. The State Highway Commission has, as yet, taken no statewide traffic census.

It can not be said in 1920, in the light of the fact that the great usefulness of the highway system is now proved, that the State would have realized its usefulness and provided funds in equal volume had not the system been extended as rapidly as it was and at some sacrifice of either temporary or ultimate durability to increased mileage. There appears, however, to be a serious question in the light of the fact that 70 per cent of the defective pavement of classes D, E and F occur on clay and adobe soils, as to the wisdom of a policy which continued the risk of a thin slab on such soils. It is undeniable, however, that a large mileage of the same thin pavement and on adverse soil still remains of classes A, B, and C. We find, however, no conclusive final demonstration of the best construction on the adverse soils and in that respect failure to vary the design on such soils in the past has postponed the solution of this problem.

The adaptability of the pavement laid to supplementary construction when it fails is indicated by about 37 miles of this work already done with 30-in. concrete shoulders and 1½-in. Topeka, or other bituminous concrete surfacing and with "second-story" concrete. None of this work is sufficiently old to prove its ultimate durability, but it appears to be carrying traffic with success.

Construction and Maintenance — The total average percentage of construction costs on both day labor and contract work, chargeable to administration, engineering and overhead, is 15.86 per cent and is reasonable. The percentage of total overruns of 6.24 per cent on final total payment on construction over the engineer's estimate, is low, in view of the recent rise in prices.

The direct charges for maintenance and improvement are found not to be excessive. The overhead and indirect charges, however, are apparently 19.2 per cent (overhead alone 12.5 per cent), which seems rather excessive. There are at present under maintenance a total of 3,293 mile of state-controlled roads. It appears that up to 1920 the commission has thought of the increase of traffic more in direct relation to the increasing maintenance costs rather than in respect to its influence on design of new construction. In 1912 the increase of traffic could not be foreseen but by the end of 1915, when 1912 registrations had nearly doubled, the 1918 registrations should have been foreseen.

Organization — The organization is highly developed. It has continued with little change since 1911. The details of the engineering standards are carefully thought out and unusually complete. There is some evidence of a cramped condition in the functioning of the organization. Headquarters control is so complete that it may inhibit those reciprocal actions necessary for healthy growth.

Conclusions

The high capillarity of adobe soils and the great shrinkage in the long hot summer produce very unfavorable conditions for a thin pavement under increasing traffic. All pavement of classes D to F inclusive, which totals 120 miles and much of which is on adobe soils is doubtless deteriorating and demands immediate repair and supplementary construction. It is doubtful if much of the pavement of these classes, especially on adobe, will ultimately prove an adequate base for a 1½-in. Topeka top. The "second story" concrete if extended to a total width of 20 ft. to thus include two new 30-in. concrete shoulders of full depth is to be preferred.

There are sufficient typical failures to show that in future only designs of increased strength and adapted to resist such failure should be used. There will be necessary every possible precaution to prevent failure on adverse subsoils of adobe, clay adobe, or similar soils. On such soils, in the absence of any proved successful design, short sections only of tentative design should be approved by the Secretary of Agriculture, or there should be first developed frank experimental construction to determine a workable and economical design for post road projects. Such a design will require the reinforcement now provided by the commission and a more massive type of concrete, not less than 6 in. in average depth and some adequate corrective treatment of subgrade and possibly a form of "mulching" of shoulders to prevent evaporation. A flat subgrade is desirable and less crown.

It is believed that on the main roads more satisfactory results will follow a considerably bolder standard of location on hill and mountain grades and that an increase in width of pavement to a minimum of 18 feet is now desirable and with more systematic widening and super-elevation on curves.

The standard of design and workmanship of structure is high and the costs have been very reasonable.

The standard of finish on concrete pavement has improved but still greater refinements will constantly be demanded and will probably pay in reduction of impact and resulting injury to and by traffic. The continued use of the ½-in. oil top is not justified by past experience and concrete should not be laid as a base but as a wearing surface.

There is nothing presented by the entire California study that indicates that concrete is not a successful pavement. One of the clearest results is the emphasis on the need of better subgrade protection.

There should be further studies with respect to traffic, fatigue of concrete, soils and alkali.

The 4-in., 15-ft. concrete pavement was continued beyond the point of success on adverse soils and more time will be needed to develop a type of construction certain of success on such soils. The operations have produced a large mileage of very serviceable road and from an economic standpoint are conspicuously successful and of continuing benefit to the State. The operating income from the highways is now sufficiently large to insure the economic success of a considerably increased standard of construction.

Mechanical Protection for Piles

From report of Committee on Wood Preservation, American Railway Engineering Association.

SINCE CREOSOTE does not stop the attacks of limnoria on piles in water infested by marine borers, mechanical protection has been applied. The piles are creosoted, however, to prevent decay above water and to retard the action of borers until repairs can be made in case the protection becomes damaged.

Cast iron casing, made in halves bolted together and pushed down into the mud, has been used on the Gulf coast for many years, but present prices make this almost prohibitive. The enclosed space is filled with sand and capped with cement mortar. Although it is stated that borers will not live behind the casing even if the sand is omitted, it is assumed that the bottom must be closed sufficiently to cut off their food supply. Vitrified pipe made in single pieces or in halves is suitable for locations not exposed to wave action and drift. It is customary to inspect and repair them every year, as the borers will not make much headway in creosoted timber in that time. Reinforced-concrete casing is less fragile than vitrified clay and less expensive than cast iron. There is some question as to whether the thinly-covered reinforcement will corrode and cause the casing to break in pieces.

Jackets of plain concrete cast in place for a length of about 10 ft. being secured by nails projecting 3 in. from the pile, have given satisfactory results since 1915 at Charleston, S. C. The concrete has been placed at depths as great as 12 ft., but unless the forms can be pumped out, it is not safe to rely on concrete placed in more than 3 or 4 ft. of water. Gunite, or concrete applied with the cement gun, was used near Seattle in 1919, but it is too soon to report results.

Nails driven into the exposed surface prove effective, even when not more than 25 per cent is covered by the heads. This method deserves more attention and study, although the application probably would be expensive. Copper and zinc sheathing has been used with success, but

he latter corrodes and the former is expensive. Rust resisting iron might be used. Sheathing must be applied before the pile is driven and is likely to be broken in handling. Coatings of tar and asphalt, either alone or combined with fabric, are likely to be broken in handling the pile or by the pounding of drift; in general they have proved unreliable. Bark left on the piles is a protection and increases the life.

The conclusion is that piles of important structures in infested waters should be thoroughly creosoted and given some mechanical protection. On the Gulf and Pacific coasts this protection should extend the full length of the pile to assure protection against both limnoria and teredo. On the Atlantic coast the creosoting will resist the teredo but mechanical protection is required to resist the limnoria.

Assay of Industrial Waste Under Way

Committee of Federated Engineering Societies Is Making Investigation of Ten Representative Industries

THE Committee on Elimination of Waste in Industry of the American Engineering Council, the governing body of the Federated American Engineering Societies, put into operation Feb. 7 a definite scheme of conducting its investigation, and on Feb. 21 reports on the first investigation in each of the following ten representative industries were made: Bituminous coal, building trades, transportation, men's ready-made clothing, printing, paper, metal trades, textiles, shoes, and rubber. The chairman of the committee is J. Parke Channing, of New York, and the vice-chairman in active charge of the inquiry is L. W. Wallace, executive secretary of the council. The work of the committee is being directed from temporary headquarters in the Engineering Societies building, New York.

The fuel work, covering principally New York, New England, and Pennsylvania, will, Mr. Wallace announced, be completed by April 1. A meeting of the planning board was held on March 1; preliminary reports were presented and further plans were made for continuing the investigation more intensively. Among the industries now under investigation and from which full reports have been received are coal, transportation, clothing, shoes, printing, textiles, and the metal trades.

Wallace Explains Work

In a statement explaining the task of the committee Mr. Wallace said:

"Herbert Hoover, when addressing the Federated American Engineering Societies, as president, in Washington last November, said: 'It is primary to mention the three-phase waste in production: First, from intermittent employment; second, from unemployment that arises in shifting of industrial currents; and third, from strikes and lockouts. Beyond this elimination of waste there is another field of progress in the adoption of measures for positive menace in production. In the elimination of the great waste and misery of intermittent employment and unemployment we need at once co-ordination in economical groups.'

"The American Engineering Council readily consented to the request of Mr. Hoover. He then formed the Committee on the Elimination of Waste in Industry. In selecting the personnel of the committee care was exercised to secure men of broad experience, of clear concepts, of unbiased attitude toward labor problems and representative of managerial, consultant, educational and editorial activities as well as having a widely distributed and varied industrial contacts.

"At the organization meeting of the committee in January the purpose of the committee was stated to be, first, to determine the cause of labor, material and equipment waste in industry—the material and equipment phases of the problem to be studied largely in so far as they may cause labor waste; second, in so far as possible, to determine the extent of the waste that arises through each major cause; third, to suggest means of removing the cause for such waste.

Scope of Inquiry

"To accomplish the purposes of the committee it was necessary to make studies along the following lines: (1) Organization—that which assigns responsibilities and relationships, and the discharge of same; (2) engineering, which comprises the design, construction and maintenance of plant, machinery and tools and the design of the product; (3) production control and cost control—under the third division fall all the factors relating directly to production and the proper direction and accounting for the same; (4) physical factors—this division relates to the storage and inspection of raw and processed materials and to matters of internal transportation. It also includes consideration of the physical condition of the plant as regards lighting, heating, toilet facilities and such like.

"Organization may be described as follows:

"(A) Nature of operation: (1) Contractual—this form presents many problems that affect personal relations; building operations are largely contractual; this form of relationship is quite common in the clothing industry. (2) Repetitive—a large portion of industrial activity is repetitive; this phase of industry makes prominent the question of monotony, and occupational diseases. (3) Continuous—steel and chemical industries are typical representatives; in this form of operation the question of bonus and shifts are considered important.

"(B) The type of organization is some index to the quality of the management and is an essential consideration.

"(C) Personal relations: (1) Employment policies; (2) representation; to what extent each plan has been tried and with what results. (3) Strikes and lockouts, the cause for, the duration of, the man, his loss, and the total cost. (4) Unemployment. (5) Seasonal and intermittent employment. (6) Health and safety factors.

Problems Involved

"In production control and cost control, planning, establishing standards, and maintenance are factors considered. The special assay involves these considerations: (1) Two shift versus three shift; this study to be made in continuous process industries. (2) Health factors in production; the American Association of Industrial Physicians and Surgeons is to assist in making this study. (3) Standardization; this subject is to be given consideration from a broad point of view, in addition to the detail information it will receive in considering internal conditions; through the standardization of equipment, of product, of methods, large economies and general improved conditions would inevitably result. (4) Stabilizing industry; through stabilization an even demand for production would ensue—hence periods of great fluctuation in employment would not obtain. Many seasonal industries could

be reorganized so as to yield a fairly uniform production throughout the year and thus greatly lessen the evils of unemployment.

"The ten representative industries, named above, were selected because of their general importance and interest to the public. From three to ten plants of each selected industry are being visited by experienced engineers who secure the information desired by the committee. A carefully proposed list of questions is placed in the hands of each field worker. The information obtained by the field investigator is supplemented by such authoritative data as may now exist in the form of reports made by reliable parties or agencies. Through this means sufficient information is to be secured to enable the committee to formulate specific conclusions as to the major causes of industrial waste."

The Committee on Elimination of Waste in Industry consists of J. Parke Channing, chairman, L. W. Wallace, vice-chairman, Robert B. Wolf, J. H. Williams, H. R. V. Scheel, Fred J. Miller, Robert Linton, C. E. Knoeppel, Herbert Hoover, L. P. Alford, George D. Babcock, F. G. Coburn, Morris L. Cooke, Harrington Emerson, Ira N. Hollis and E. E. Hunt.

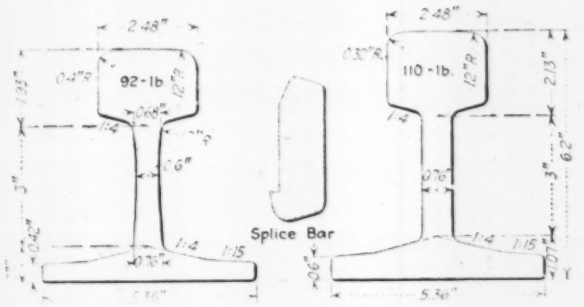
Standard Rails and Splice Bars on French Railways

GOVERNMENT STANDARDIZATION of track material for the French railways was decided upon in 1917 at a conference between the minister of war and the heads of the railway systems, a commission of engineers being appointed to prepare the necessary designs. On the recommendation of this commission standard sections for rails and splice bars have been adopted, there being one 52-lb. rail for narrow-gage lines, 72-lb. and 92-lb. rails for standard-gage lines of light and heavy traffic respectively, and a 110-lb. section for tunnels. The last two are shown in the accompanying drawing.

NEW FRENCH STANDARD RAIL SECTIONS

	French, Open Track	French, Tunnel	A. R. E. A.
Weight per yard	92 lb.	110 lb.	90 lb.
Height	5 80 in.	6 2 in.	5½ in.
Width of base	5 36 in.	5 36 in.	5½ in.
Width of head	2 48 in.	2 48 in.	2⅜ in.
Depth of head	1 93 in.	2 13 in.	1⅞ in.
Depth of web	3 00 in.	3 00 in.	3⅜ in.
Depth of base	0 87 in.	1 07 in.	1 in.
Thickness of edge of base	0 42 in.	0 60 in.	⅜ in.
Thickness of web	0 60 in.	0 76 in.	½ in.
Fishing angles	1 on 4	1 on 4	1 on 4
Radius of web	17 in.	Vert.	14 in.
Radius, top of head	12 00 in.	12 00 in.	14 in.
Radius, corners of head	0 40 in.	0 32 in.	½ in.
Height to center of bolt hole	2 37 in.	2 57 in.	2⅜ in.
Side of head, slope	Vert.	Vert.	1 on 16
Bolt hole, diameter	1 04 in.	1 04 in.	

All the rails are of the flange type, thus eliminating the double-head type now used on some of the French main lines which require heavy cast-iron supporting chairs on each side. The new sections closely resemble present American standards. In fact an article in the *Revue Generale des Chemins de Fer* by M. Froebe, engineer of track material of the State Railways, states that it was proposed to adopt an American standard, but that this plan was abandoned on account of the relatively thin edge of the rail base. In French practice the ties are slightly notched to receive the rail, the shoulder thus formed being relied upon largely to maintain the gage. It was considered, therefore, that rails of the American section would tend to cut the wood shoulder and widen the gage. [Presumably the French were considering the Am. Soc. C. E. standard sections, as the A.R.E.A. sections are distinctly heavier than the former at the edge of the base.]



NEW STANDARD RAILS OF FRENCH RAILWAYS FOR OPEN TRACK AND TUNNELS

The French standard sections differ from the older rails especially in the fishing angles, the web thickness and the width of base. In the old iron rails the slope of the fishing surfaces were generally 1 on 1 in order to facilitate rolling, but the head then acted as a wedge to separate the splice bars and strain the bolts. The same experience was encountered in some of the early American rails. When steel rails were introduced in France the slope was reduced to 1 on 2, although in other countries it was very generally 1 on 4. As the flatter slope gives a better support to the rail under load, a 1 on 4 slope has been adopted in the new section.

Thin webs of uniform thickness have been a characteristic of French rail sections, and as the web metal is harder than that of the head and base there have been frequent fractures through the bolt holes. Many railways in other countries, including the United States, have given a curved form to the sides of the rail web, thus increasing the thickness towards the junctions with the head and base. This feature has been adopted in the new French rails.

Narrow base width has been another characteristic of French rails, although American standard sections make the width of base equal or nearly equal to the height. Although the wide base gives a better support, it adds to the difficulties of rolling and the French engineers therefore adopted a compromise in the new sections. They considered also that the French screw spikes hold the rails more securely than the American drive spike and that this feature makes it practicable to use a smaller base width. In American sections the 1 on 4 slope of the base is continuous, but in the French sections this slope extends only over the fishing surface and is then reduced to 1 in 15 in order to give the desired thickness at the edge of the base.

Heavy plain splice bars or fish plates are to be used for the rail joints, the angle bar being considered to present little or no advantage, especially as a close spacing of 16.8 in. c. to c. has been adopted for the joint ties. The bars, which have a narrow rib along the lower edge, are 1.2 in. thick for the 92-lb. rail.

Rails in tunnels being subject to corrosive action from damp atmosphere and the gases from the engines, a special 110-lb. rail section has been adopted for use in tunnels on lines using the 92-lb. section on open track. In this section the head and web are unusually thick, and the web is made of uniform thickness. The same splice bars serve the 92-lb. and 110-lb. rails.

ENGINEERING LITERATURE

Remarks on Engineers' Autobiographies and That of James Nasmyth

BY EDGAR A. VAN DEUSEN
Jackson, Mich.

AUTOBIOGRAPHIES of engineers are almost rare enough to be unique. In the case of the "Reminiscences of a Municipal Engineer" by H. Percy Boulnois (reviewed in the *Engineering News-Record*, Jan. 20, 1921, p. 128), the author states that he is unaware of the existence of any other than his own. The reviewer, however, calls attention to McCarthy's "Incidents" and Corbett's "Reminiscences."

The list is not complete, however, without mentioning "James Nasmyth, Engineer: An Autobiography," edited by Samuel Smiles. The book was published by Harpers, in 1883, and is generously illustrated with cuts and engravings from paintings and sketches by the author and his father, Alexander Nasmyth.

James Nasmyth was born in Edinburgh, Scotland, in 1808. His father was Alexander Nasmyth, a prominent painter and architect, and usually conceded to be the "founder of landscape painting in Scotland." James Nasmyth's autobiography is rich in reminiscence of his early days in the old Scottish capital, and of his intimacy with such of his father's friends as Walter Scott, Robert Burns, James Ballantyne, and others. It is here that Americans may learn that the birthplace of the skyscraper is not America, for one finds Nasmyth speaking of twelve and fourteen story buildings as in existence in Edinburgh more than one hundred years ago.

Young Nasmyth very early showed both an artistic and a mechanical bent, and received training along both lines. His mechanical ingenuity predominated, however, so that, even when a mere lad, he built and sold several steam engines and other contrivances of his own design.

His first sight, when a boy, of James Watt, then eighty-two years old, made a great impression on him, for he says, "his benevolent countenance, and his tall but bent figure made an impression on my mind that I can never forget." Meetings and dealings with such contemporaries as Faraday, Maudsley, George and Robert Stephenson, Bessemer and Sir John Herschel, are spoken of as enjoyable and valuable experiences.

The story of his many inventions, including the steam-hammer, the steam pile-driver and many other less known contrivances, make entertaining reading for engineers at all interested in the history of engineering, particularly the mechanical and machine-tool branch. A competition in pile-driving between the old hand pile-driver method and his new steam-hammer pile-driver on a Government dock-yard contract is described as follows:

> "At a given signal we started together. I let in the steam and the hammer at once began to work. The four-ton block showered down blows at the rate of eighty a minute and in the course of four and a half minutes my pile was driven to its required depth. The men working at the ordinary machine had only begun to drive. It took them upward of twelve hours to complete the driving of their pile."

His part in the building up of the great iron and steel industry of England, and the allied mechanical industries, is told in a fascinating but modest way. The methods employed by him for handling the difficult strike situations which arose from time to time during the operation of his large Bridgewater foundries and shops, and at a time when the trade unions were becoming conscious of a growing power, make thought-provoking reading for American engineers in these days of union ridden industry.

That Nasmyth was anything but an average engineer, from the financial point of view, is evidenced by the fact that at the age of forty-eight years he had amassed sufficient fortune, in the practice of his profession, to enable him to retire from active business. The same zeal, skill and ingenuity that characterized his engineering, he now brought to bear on astronomy, a hobby which amounted almost to a passion. Many improvements in the construction of telescopes resulted from his labors, and numerous astronomical papers and books came from his pen, including a monumental treatise on the moon.

Hobnobbing as Nasmyth did with the great Victorian scientists and engineers, his autobiography is naturally replete with incidents relating to those fine pioneering spirits. It is full of "human interest," as well as technical record, and will well repay, in enjoyment and information, the careful perusal of the engineer of today.

For the sake of historical record, of engineering example, and of inspiration, it is to be hoped that we may have more biographies and autobiographies of the world's leading engineers.

This Lapse Has Been Corrected

Sir—So many valuable articles have been contributed to *Engineering News-Record* by R. Fleming that its subscribers will read with interest any subject treated by him, even if it is on "A Few Lapses in Textbooks" (see your issue of Jan. 20, p. 125). The error which occurred formerly in the Textbook on Roofs and Bridges, Part I, about the maximum stress in any diagonal of a lateral system due to initial tension and wind stress, was corrected in 1919. As corrected, the last two sentences in the third paragraph of Art. 55, now read as follows: "In case the greatest wind stress S_w in either diagonal be equal to twice the initial tension S_i the effect of the latter entirely disappears in every member of the panel. Therefore, if the wind stress be less than this amount, the maximum stress equals $S_w + \frac{1}{2}(2S_i - S_w)$; and if the wind stress be greater, its value will be the maximum stress." HENRY S. JACOBY.

Ithaca, N. Y., Feb. 23.

Another Plea for the Personal Pronoun

Sir—Let me join with Mr. Brady and Prof. McDonald (*Engineering News-Record*, Jan. 20 and Feb. 17, pp. 125 and 307) and may there be a chorus of protest against the conspicuous and absurd avoidance of the first personal pronoun in engineering papers and discussions.

The American Society of Civil Engineers, or rather

its publication committee, now quite a number of years ago conceived an abject fear of this useful part of speech, rigidly substituting the third person for the first, going to the length of doing so even in oral discussions, anyone referring to himself being made to say "the speaker," at least by the time he appeared in print. On return post cards it was "the writer," for years. This I persistently scratched, as no doubt did others, and eventually, behold, return to the single letter of the first personal pronoun instead of the nine printed before on acknowledgment cards.

The first personal pronoun is incisive, and alive; replacing it by the third person is, in most cases, stilted circumlocution. W. H. BREITHAUPT.

Kitchener, Ont., Feb. 24, 1921.

For Concrete Foremen and Workmen

CONCRETE WORK: A Book to Aid the Self-Development of Workers in Concrete and for Students in Engineering — By William Kendrick Hatt, C.E., Ph.D.; M. Am. Soc. C.E.; M. Am. Soc. T.M.; M. Soc. Prom. Eng. Ed.; President, American Concrete Institute, etc., and Walter C. Voss, B.S.; Assoc. M. Am. Soc. C.E.; M. Am. Soc. T.M.; M. Am. Con. Inst.; Head, Department of Architectural Construction Wentworth Institute, Boston, Mass., etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 451; illustrated. $4.

For some years a few educators have been working on a system of engineering instruction which is deductive rather than inductive; that is, they have taken some particular job or structure and have led their students from that structure as the performer of some necessary duty down through the various processes of analysis to the elementary theories on which the design of the structure was based. During the war this system was particularly successful in the vocational or trade schools of the army. The book noted above is one of the first results of this war instruction. Both of the authors were connected with the vocational schools of the army and both have, in addition, had long experience in what might be termed the more theoretical instruction of engineering students. The volume which they have produced, which is the first of two on the same subject, is therefore a definite exposition of the newer method of engineering instruction by men who are well acquainted with the old methods as well.

The second volume of the work is to include a number of jobs in concrete construction by accomplishing which, according to the authors, the worker will learn the how and why of the elements entering into concrete construction. This second volume is frequently referred to in the first one, so that a complete analysis of the two volumes cannot yet be made. But it is evident from the volume now available that a remarkably effective piece of engineering literature has been produced. For a great while it has been evident that one of the main troubles with concrete construction is the lack of appreciation on the part of the worker and of his foreman of the essentials of concrete theory and practice. These men are "practical" men, with all of the faults which that adjective implies. There has been great need for their education, but just how such an education is to be conducted has been difficult to see. Professors Hatt and Voss have attacked this problem. Their book is intended for just such men, as well as for those who are entering the concrete business for the first time with no previous technical knowledge or practical experience. Whether the book is useful for self instruction is doubtful, but with proper direction it certainly affords the best means available for one to learn the essentials of concrete building.

Architectural Practice

A HANDBOOK OF ARCHITECTURAL PRACTICE—Issued by the American Institute of Architects for Use in Connection with Its Standard Documents. Washington, D. C.: The Institute. Cloth; 8 x 11 in.; pp. 204.

This book is issued by the American Institute of Architects and fully satisfies the rather broad import of its title. In includes the details of work which an architect must do in his relation to his clients and to the men who carry out the work for his clients and also the numerous valuable documents which have been been issued by the Institute in the form of standard contracts, agreements, etc. Chapter headings will give some indication of the scope of the work. They are: The Architect and the Owner, The Architect's Office, Surveys, Preliminary Studies of Estimates, Working Drawings and Specifications, The Letting of Contracts, Execution of the Work, The Architect and the Law, and Documents of the American Institute of Architects. These documents include such things as memoranda of procedure and progress, a circular of advice relative to principles of professional practice, architectural competitions, standard form of agreement between owner and architect, the fee-plus-cost system of charging, standard form of agreement between contractor and owner, standard form of bonds, form of law for registration of architects, etc.

Office systems, methods of keeping books and records, instructions as to competition, schedule of duties on work, relations of the architect and law, partnership agreements, are some of the subjects covered. All in all, the information included is invaluable and should be in the hands of every architect. Engineering societies could well study the form of book for possible use in their own field.

Comprehensive Work on Gas Distribution

A MANUAL OF GAS DISTRIBUTION—Edited by Walton Forstall, Engineer of Distribution, Philadelphia Gas Works. Philadelphia, Pa.: The U. G. I. Contracting Co. Cloth; 6 x 9 in.; pp. 968; illustrated.

It is a great pity that the water-works of the country, which antedated and have always outnumbered the gas works, still lack any approach to such a comprehensive manual as Mr. Forstall has produced. The book is largely based on the author's experience on the Philadelphia gas works which dates from 1898; but he gives particular consideration to the needs of gas men in small cities. The broad scope of the book is indicated, but only in part, by its main heads: Administration, design, equipment, mains, services, street lighting, meters, house piping and fixtures, appliances, and the storeroom. Much attention is given to both organization and records. Water-works men in particular and managers and staff members of utilities in general would find many helpful suggestions in the book.

Road Construction Notes from Hong Kong

MODERN ROAD CONSTRUCTION AND MAINTENANCE—By Henry Edward Goldsmith, Executive Engineer in Charge of Roads, Hongkong, M. Municipal and County Engineers' Institute, M. Royal Sanitary Institute, etc. Hongkong, China; Kelly & Walsh, Ltd. Cloth; 6 x 9 in.; pp. 140; illustrated.

Notes made while improving roads in the Colony of Hong Kong comprise much of the brief text of this book. Data gathered from other sources are included. The main topics are setting out work, footpaths, curbs and gutters, testing materials, water-bound and asphaltic macadam, asphaltic concrete and sand carpeting, tar macadam, bituminous surface and concrete roads. Appendices deal with nomenclature, sampling, specifications and contracts.

More About Herbert Hoover

HERBERT HOOVER: The Man and His Work—By Vernon Kellogg, Author of "Headquarters Nights," etc. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 376. $2.

Three months ago (Dec. 16, 1920, p. 1201) there appeared in these columns a review of "The Making of Herbert Hoover," by Rose Wilder Lane. The volume now before us deals—from the viewpoint of "an observer, associate and friend"—more particularly with Hoover's later life, especially with his great relief and food work, from 1914 to 1920. But this does not mean that Mr. Hoover's boyhood, and his student life at Leland Stanford and his remarkable rise as a mining engineer, organizer and administrator up to the outbreak of the world war is not adequately sketched. Both the lives of Hoover deserve a place in every engineer's library and a wide reading by the youths and parents of the land.

Social Medicine and Community Health

THE COMMUNITY HEALTH PROBLEM—By Athel Campbell Burnham, M.D., Health Service, Atlantic Division, American Red Cross; Attending Surgeon, Volunteer Hospital, N. Y. C., etc. New York: The Macmillan Co. Cloth; 5 x 7 in.; pp. 149. $1.60.

The author's attempt to present "in one small volume a fairly comprehensive understanding of social medicine in its relation to community health" has been realized. Attention is given to the prevention of all kinds of sickness and to health improvement in general. Throughout, health is considered as a community problem, to be promoted by all possible agencies, but always through action by and for individual communities—the latter extended to relatively small health and social centers. Arguments for the socialization of medicine and for efforts directed to the prevention rather than the cure of disease are ably presented. Workmen's compensation, health insurance, industrial hygiene and accident prevention are reviewed.

Principles of Highway Construction

AMERICAN RURAL HIGHWAYS—By T. R. Agg, C. E., Professor of Highway Engineering, Iowa State College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 139; illustrated. $2.

An exposition of the broad general principles that underlie modern highway construction, maintenance and administration is achieved in this book. The author attempts no explanations of involved theory nor formulas. He seeks merely to give a thorough grounding in not only the essentials of road construction, but in its economic aspects as well. Separate chapters on administration—town, county, state and Federal—the purpose and utility of highways, drainage, design and the various types of surfacing, give the volume a well-rounded appearance and make it a good text for the agricultural engineer and a valuable reference for the popular reader who has no technical or personal interest in highway work.

A Short Manual on Landing Fields

MUNICIPAL LANDING FIELDS AND AIR PORTS: With Chapters by the Chief of the Army Air Service, the Director of Naval Aviation, and Their Officers in Charge of Landing Field Operations—Compiled and Edited by George Seay Wheat. New York and London: G. P. Putnam's Sons. Cloth; 5 x 8 in.; pp. 96; illustrated. $1.75.

Officers of the army and navy air services, officials of the Wright Aeronautical Corporation and others, have collaborated in presenting short essays on the need of landing fields, how to construct them, hangars, aerial routes, naval air ports and airplanes and seaplanes. An appendix gives a long list of landing fields, arranged by states, with designations of emergency, municipal and federal. There is also a folding aerial map of the United States, compiled in January, 1920, under the direction of the War Department.

British Notes on Concrete Roads

CONCRETE ROADS AND THEIR CONSTRUCTION: Description of the Concrete Roads in the United Kingdom, Together with a Summary of the Experience in this Form of Construction Gained in Australia, Canada, New Zealand and the United States of America. London: Concrete Publications, Ltd. Cloth; 6 x 9 in.; pp. 197; illustrated. 8/ net, postpaid 8/6.

About half of this book is taken up with descriptions of concrete roads in the United Kingdom, including the methods employed in their construction and statements regarding their condition at the time of writing—often as late as November and December, 1920. Two short chapters deal with concrete roads in (1) New Zealand, Australia, and Canada, and (2) in the United States. The last-named chapter was written by Thomas J. Harris. It contains less than five pages of text and is mere outline of the rapid spread of concrete roads in the United States. But in the chapter on Mechanical Devices for Making Concrete Roads, there are a number of references to American machines. Concluding chapters take up "Kerbing" specifications and road accessories made of concrete.

Municipal Review Enlarges Scope

With the new year the *National Municipal Review* (261 Broadway, New York City) became the "official mouthpiece" of the National Conference on City Planning, with Frank B. Williams as city planning editor. At the same time the *Review* also became the "organ" of the American Civic Association, which organization and the National Municipal League have begun a "year's co-operation" that may result in a merger of the two bodies.

PUBLICATIONS RECEIVED

COLORED WALL PLASTER—By Warren E. Emley, Chemist; Charlotte F. Faxon, Laboratory Assistant, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; illustrated. 5c. from Superintendent of Documents.

COMMERCIAL STATISTICS—Compiled by The Board of Engineers for Rivers and Harbors—Washington, D. C.: The Board. Paper; 6 x 9 in.; pp. 779.
Buried heretofore in the massive and unwieldy Chief of Engineers' Annual report, these data are now for the first time published separately. They are most valuable for reference, giving as they do the latest available figures on the Commerce of the ports of the United States.

CONCRETE HOUSES: How They Were Built; Articles Descriptive of Various Types of Concrete Houses, and the Details of their Construction, Compiled from Concrete—Edited by Harvey Whipple, Editor of Concrete. Detroit, Mich.: Concrete-Cement Age Publishing Co. Cloth; 9 x 12 in.; pp. 215; illustrated.
Enlarged edition of a book first published in 1917. Articles describing houses and groups, and giving various details.

CONNECTICUT DEPARTMENT OF HEALTH: Report of John T. Black, M.D., Commissioner of Health—Hartford, Conn.: The Department. Paper; 6 x 9 in.; pp. 42; illustrated.

ECONOMIC DEVELOPMENT OF THE UNITED STATES—By Isaac Lippincott, Ph.D., Professor of Economic Resources, Washington University. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 691. $3.50.

EDUCATION FOR CITIZENSHIP: Prepared for the War Department by Profs. J. G. de Roulhac Hamilton and E. W. Knight, of the University of North Carolina—Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 30.
An exposition of a further development of the work done by Aydelott during the war and of the ideas suggested in the Mann report.

EXCESS PROFITS TAX PROCEDURE, 1921: Including Federal Capital Stock (Excise) Tax—By Robert H. Montgomery, C. P. A. of Lybrand, Ross Brothers and Montgomery; Attorney-at-Law; etc. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 594. $4; or sold with "Federal Income Tax Procedure," 1921, mentioned below, $10.

FACTORY ADMINISTRATION AND COST ACCOUNTS: A Reference Book of the Principles and Practice of Industrial Administration and Costing for Present Day Requirements—By Edward T. Elbourne of Messrs. Brindley & Elbourne, Consulting Engineers on Factory Organization and Costing Systems. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 811; illustrated. $15.

FEDERAL INCOME TAX PROCEDURE, 1921—By Robert H. Montgomery, C. P. A. of Lybrand, Ross Brothers and Montgomery; Attorney-at-Law, etc., New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 1206. $8; or sold with "Excess Profits Tax Procedure," mentioned above, $10.

FESTIGKEITSEIGENSCHAFTEN UND GEFUGEBILDER DER KONSTRUKTIONSMATERIALIEN—Von Dr.-Ing. C. Bach und R. Baumann, Professoren an der Technischen Hochschule Stuttgart. Sweite, Stark Vermehrte Auflage. Berlin, Germany: Verlag von Julius Springer. Cloth: 8 x 11 in.; pp. 190; illustrated. 80m.

FINDING AND STOPPING WASTE IN MODERN BOILER ROOMS: A Reference Manual to Aid the Owner, Manager and Operator in Securing and Maintaining Boiler Plant Economy. Second Edition, Revised and Enlarged. Philadelphia, Pa.: H. S. B. W.-Cochrane Corp. Flexible; 5 x 7 in.; pp. 414; illustrated. $1.

THE FLY—By George W. Simons, Jr., Chief Sanitary Engineer, Florida State Board of Health. Jacksonville, Fla.: State Board of Health. Paper; 6 x 9 in.; pp. 11; illustrated.

THE FUNDAMENTAL PRINCIPLES OF WATER POWER ENGINEERING: Describing Types, Applications and Operation of Water Turbines, and Developing the Fundamental Formulæ of Waters Power Engineering—By Frank F. Fergusson, C.E., Assoc. M. Inst., C. E., Assoc. M. Am. Soc. C. E. London, Eng.: Sir Isaac Pitman & Sons, Ltd. Cloth; 4 x 7 in.; pp. 116; illustrated. $1.

GOVERNMENT WAR CONTRACTS—By J. Franklin Crowell, Ph.D., LL.D.; Preliminary Economic Studies of the War—Edited by David Kinley, Professor of Political Economy, University of Illinois, Member of Committee of Research of the Endowment (Carnegie). Washington, D. C.: Carnegie Endowment for International Peace. Paper; 7 x 10 in.; pp. 357.

HEAT TRANSMISSION CORKBOARD AND AIR SPACES—By Arthur J. Wood and E. F. Grundhofer. State College, Pa.: The Engineering Experiment Station of The Pennsylvania State College. Paper; 6 x 9 in.; pp. 139; illustrated.

HUMAN ENGINEERING: A Study of the Management of Human Forces in Industry—By Eugene Wera, M.E., E.E., Industrial Engineer; Assoc. M. A.S.M.E. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 378. $3.50.

HYDRO-ELECTRIC SURVEY OF INDIA, Vol. II: Report on the Water Power Resources of India, 1919-20—By F. E. Bull, Chief Engineer, Hydro-Electric Survey of India, and J. W. Meares, M.Inst.C.E., M.I.E.E., M.Am.I.E.E., Electrical Adviser, Government of India. Calcutta, India: The Survey. Cardboard; 6 x 9 in.; pp. 123; folding map.

HYDROMETRIC SURVEY OF MANITOBA: Progress Report, 1918-19—By C. H. Attwood, A.M.E.I.C., District Chief Engineer. Prepared under the Supervision of the Director of Water Power. Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 92; folding map.

KINEMATICS AND KINETICS OF MACHINERY: A Text Book for Colleges and Technical Schools—By John A. Dent, M.E., Associate Professor of Mechanical Engineering, University of Kansas, and Arthur C. Harper, M.E., Head Instructor of Machine Design, Pratt Institute. New York: John Wiley & Sons, Inc. London: Chapman & Hall, ltd. Cloth; 6 x 9 in.; pp. 383; illustrated. $3.50.

An engineering school textbook based by the authors on notes by Prof. G. A. Goodnough used for some years in teaching the subject indicated at the University of Illinois, with which is included "almost without change," a paper on the gyroscope by Prof. F. B. Seely, also of Illinois. The authors of the present book have added chapters on toothed wheels, cams, wrapping connectors and critical speeds.

MAJOR TRAFFIC STREET PLAN BOULEVARD AND PARK SYSTEM FOR PORTLAND, OREGON—Presented by The City Planning Commission, Charles H. Cheney, Consultant. Portland, Ore.: The Commission. Paper; 6 x 9 in.; pp. 97; illustrated.

MASONRY STRUCTURES—By Frederick P. Spalding, Professor of Civil Engineering, University of Missouri. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 404; illustrated. $3.50.

THE MECHANICAL WORLD ELECTRICAL POCKET BOOK, 1921: A Collection of Electrical Engineering Notes, Rules, Tables and Data. London, Eng.: Emmott & Co., Ltd. Cloth; 4 x 6 in.; pp. 376; illustrated. 2/ net.

NATIONAL SAFETY CODE FOR THE PROTECTION OF THE HEADS AND EYES OF INDUSTRIAL WORKERS. Washington, D. C.: Bureau of Standards. Paper; 5 x 7 in.; pp. 64; illustrated. 10c. from Superintendent of Documents.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISIONERS: Reports February, 1919, to March, 1920. Trenton, N. J.: The Board. Cloth; 6 x 9 in.; pp. 564.

NEW JERSEY SEWAGE WORKS ASSOCIATION: Proceedings, 1920. Trenton, N. J.: The Association. Paper; 5 x 8 in.; pp. 44.

THE NEW STONE AGE—By Harrison E. Howe. New York: The Century Co. Cloth; 5 x 8 in.; pp. 289; illustrated. $3.

In general this book is too scientific to be popular and too popular to be scientific, but it will probably serve its purpose as a "book of useful science." The author has been well guided to some of the recent theories and practices of concrete manufacture but has played them up too strongly.

NOTES ON SMALL FLOW METERS FOR AIR, ESPECIALLY ORIFICE METERS—By Edgar Buckingham, Physicist, Bureau of Standards. Washington, D. C.: The Bureau, Paper; 7 x 10 in.; pp. 15; illustrated. 5c. from Superintendent of Documents.

OREGON STATE HIGHWAY COMMISSION: Report, 1918-20. Salem, Ore.: The Commission. Paper; 6 x 9 in.; pp. 425; illustrated.

PACIFIC COAST ASSOCIATION OF PORT AUTHORITIES: Proceedings and Papers of Seventh Annual Convention. Seattle, Wash.: The Association. Paper; 6 x 9 in.; pp. 143.

PENNSYLVANIA COMMISSION ON CONSTITUTIONAL AMENDMENT AND REVISION: Report to the General Assembly. Harrisburg, Pa.: The Commission. Paper; 6 x 9 in.; pp. 413.

Numerous proposed changes in the state constitution, relating to utilities, social welfare, taxation, city debt limits, benefit assessments, city zoning, excess condemnation, municipal home rule and other subjects have been embodied in a draft of a proposed new constitution. The commission recommends a referendum vote to decide whether a constitutional convention be called; a reference to the convention, if ordered held, of the proposed new constitution; and finally a referendum vote on whatever document the convention may name.

PURIFICATION OF SEWAGE AND WATER: Investigations at The Lawrence Experiment Station, 1919—By H. W. Clark. Reprinted from the Fifth Annual Report of the Massachusetts State Department of Health. Boston, Mass.: The Department. Paper; 6 x 9 in.; pp. 22.

REPORT ON ROAD MATERIALS ALONG THE ST. LAWRENCE RIVER, FROM THE QUEBEC BOUNDARY LINE TO CARDINAL, ONTARIO—By R. H. Picher. Ottawa, Can.: Department of Mines. Paper; 6 x 9 in.; pp. 65; illustrated.

ADMINISTRATION OF THE ROCHESTER BUREAU OF BUILDINGS: Report in the Department of Public Safety Submitted to the Mayor, the Commissioner of Public Safety and the Fire Marshal. Rochester, N. Y.: Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 57.

SANITATION IN COUNTRY PLACES: The Theory and Practice, Including the Bacteriolytic Tank System—By W. Ramsay Smith, M.D., D.Sc., F.R.S. (Edin.), Permanent Head of the Department of Public Health of South Australia; Fellow of the Royal Institute of Public Health of Great Britain, etc. Fifth Edition. Adelaide, Australia: The Author. Paper; 6 x 9 in.; pp. 36; illustrated.

Advocates and explains use of dry-earth closets where water-carriage system is not employed and a two-compartment tank with discharge into a soak-pit to remove excreta. Assumes anaërobic action in first compartment and aërobic action in second compartment of tank. From Sept. 23, 1908, to April 30, 1920, plans for 1686 bacteriolytic tanks have been approved by the Central Board of Health of South Australia.

SASKATCHEWAN WATER SUPPLY COMMISSION: Synopsis of Report on the Feasibility of Diverting a Supply of Water from the South Saskatchewan River for Domestic and Industrial Purposes in the Moose Jaw-Regina District. Regina, Sask.: The Commission. Paper; 6 x 9 in.; pp. 45; illustrated.

SOUTHERN PINE MANUAL OF STANDARD WOOD CONSTRUCTION—Eighth Edition. New Orleans, La.: Southern Pine Association. Cloth; 4 x 7 in.; pp. 186. $1.

New data include minimum live floor loads, safe column loads, information on sheet piling, lattice trusses, Howe roof trusses and additional standard handbook data.

STEEL RAILS FROM SINK-HEAD AND ORDINARY RAIL INGOTS—By George K. Burgess, Physicist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 61; illustrated. 20c. from Superintendent of Documents.

THE SWIMMING POOL—By Jack J. Hinman, Jr., Water Bacteriologist and Chemist, Laboratories for the State Board of Health, State University of Iowa. Iowa City: The Author. Paper; 6 x 9 in.; pp. 17; illustrated.

THE TESTING OF MOTIVE-POWER ENGINES: Including Steam Engines and Turbines, Locomotives, Boilers, Condensers, Internal Combustion Engines, Gas Producers, Refrigerators, Air Compressors, Fans, Pumps, Etc.—By R. Royds, M.Sc., A.M.I. Mech.E., Head of Motive-Power Engineering Dept., Dundee Technical College. Second Edition. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 392; illustrated. $7.50 net.

The first edition was reviewed in the Engineering Literature supplement of *Engineering News*, Jan. 18, 1912, p. 130.

TRAIN OPERATION BY SIGNAL INDICATION: Part I: The Principal Methods of Directing Train Movements; Part II. Directing Train Movements by Signal Indication—By Henry M. Sperry, M. Am. Soc., C. E. New York: The Author, 347 Madison Ave. Paper; 7 x 10 in.; pp. 28; illustrated.

A review and analysis of the two principal methods of directing train movements generally in practice; namely, the time-interval method and the space-interval method, together with a comparison of safety and operating efficiency. This is followed by discussion and analysis of train orders vs. signal indications, single-track operation without written train orders, progress in the installation of block signals and operating efficiency, with appendices on the principles of train dispatching and decreased costs through increased average speeds.

VORLESUNGEN ÜBER INGENIEUR-WISSENSCHAFTEN—Von Georg Christoph Mehrtens, Geh.—ofrat Und Professor der Ingenieur-Wissenschaften An Der Technischen Hochschule in Dresden. Sweiter Teil Eisenbrückenbau. Eisenbrücken Im Allgemeinen. Vollwand-Und Rahmenträ-gerbrücken. Leipzig, Germany: Verlag Von Wilhelm Engelmann. Paper; 7 x 10 in.; illustrated. 32m.

THE WELDING ENCYCLOPEDIA: A Practical Reference Book on Autogenous Welding—Compiled and Edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of The Welding Engineer. Chicago, Ill.: The Welding Engineer Publishing Co. Cloth; 6 x 9 in.; pp. 326; illustrated. $5.

Contains a section giving a large amount and variety of information arranged alphabetically by topics; a compilation of state, federal and other rules on welding; a buyer's index and other material on the growing subject and practice of welding.

WIRTSCHAFTLICHE VERWERTUNG DER BRENNSTOFFE: Kritische Betrachtungen Zur Durchführung Sparsamer Wärmewirtschaft—Von Dipl-Ing. G. De Grahl, Baurat, Berlin-Schoneberg. Zweite, Den Schwierigen Wirtschaftlichen Verhältnissen Angepasste Und Daher Vollstädig Neu Bearbeitete Auflage. Berlin, Germany: Druck Und Von R. Oldenbourg. Paper; 8 x 11 in.; pp. 487; illustrated. Paper; 110m.; Bound 120m.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Comments on the Belgian Specification for Structural Steelwork

Sir—Some comments regarding the Belgian standard specification for structural steelwork, an abstract of which was given in your issue of Jan. 13, p. 71, may not be amiss. It is evident that the specification was prepared with care, and as representing the resultant opinion of a national association it commands attention.

Assuming a "standard" pressure for wind loads and using coefficients of that pressure for various heights and conditions has much to commend it, though objections can easily be raised. The standard pressure of 20 lb. per sq.ft. agrees with the Chicago Building Code, though many codes require more. The 41 lb. to 62 lb. for buildings outside of Belgium seems high, but probably the compilers had sugar mills mainly in mind, and these are often in localities subject to terrific winds. The Honolulu Iron Works Co., of New York City, which has had a large and varied experience in the building of sugar mills, usually designs for a horizontal wind pressure of 40 lb. per sq.ft., assumed as the resultant of a velocity of 100 miles per hour. E. W. Walker, their engineer, advises that a sugar mill recently erected by them in Formosa was designed for a velocity of 125 miles per hour.

The normal pressure on roofs and inclined surfaces obtained from the Belgian formula is much less than that from the Duchemin formula, being only one-half as much for the common slope of 6 in. to 1 ft. The teachings of the school of Stanton and other English writers, as well as of some American professors, are seen in the requirement that for monitors and roofs resting on walls an uplift of 0.7 times the standard pressure shall be assumed. Unfortunately the loads on the sides of buildings are not clearly specified. Reduction of wind pressure when truss and column are treated as a rigid frame is an interesting point, not found in American specifications. The allowable 20 per cent reduction for the wind loads alone in combination with snow and moving loads is in contrast with American practice, where usually wind stresses are neglected unless they exceed 50 per cent of the live and dead load stresses.

As the reduction for floor loading on columns is stated to be taken from American practice it is inferred that the 90 per cent of full value is intended for the uppermost floor, the 85 per cent for the floor next below and decreasing percentages for floors below until 50 per cent is reached. This is a common American practice, though the Boston code of 1919 allows the same percentage of reduction for all floors above the section of column considered. Here again the Belgian specification does not state clearly what is intended.

The assumption of a standard unit working stress, using coefficients therewith for determining the tension, bending and compression streses, similar to the method of assuming a standard wind load, has both advantages and disadvantages which need not be discussed here. The figure of 17,000 lb. per sq.in. is in general commendable; it could also have been applied to crane girders and crane columns, instead of 14,200, by adding 20 per cent impact to crane stresses. Rivet bearing 2½ times the shear is rather high, unless the bearing is enclosed. Tension on bolts and rivets at the stress fixed for shear is certainly too high, and it is not easy to see any reason for figuring bolt tension on gross section—curiously enough, anchor bolts are figured for section at root of the thread.

The distinction made between compression members of solid web-section and open web-section is practically ignored in all but a very few American specifications by the requirement that the segments of latticed columns shall have as great an l/r for the portions between panel points as for the whole column. The time may be near when a smaller l/r for the segments will be required than for the column as a whole. If so, a clause embodying the principle of that of the Belgian specification will be pertinent. In general, column stresses according to the specification, are not far from those of the formula $16{,}000 - 70\ l/r$, for column lengths of 60 to $100r$, but are lower for both longer and shorter columns.

The formula for column shears gives values that are decidedly small for short columns. For latticed columns with l/r (in a plane parallel to the lattice bars) of the same value both for the column as a whole and the segments between connecting rivets of lattice bars, the column shears are: When $l/r = 20$, 0.5 of 1 per cent; $l/r = 40$, 1.1 per cent; $l/r = 80$, 3 per cent; $l/r = 100$, 4½ per cent of the axial load on the respective columns. A common requirement in American specifications is that column shears be assumed at 2 per cent of the axial load; the A. R. E. A. specifications of 1920 require 2½ per cent.

The formula for the compression flanges of lattice girders to resist side buckling is quite complex. An effort is made to take advantage of the lower flange of a girder to help the top flange, a proceeding of doubtful value. The sentence, "Plate girders without lateral bracing are to be designed in such a way that lateral buckling of the compression flange cannot occur" leaves too much to the designer. A more serviceable provision is found in American specifications: that where the unsupported length of the compression flange exceeds 10 times its width, the compression shall not exceed that obtained by a given formula, for example, $19{,}000 - 250\ l/b$.

The requirements regarding single angle members in both tension and compression at first reading seem needlessly severe, especially where the end connections contain but one rivet. Owing to difficulties in frabrication and erection, connections with single rivets are seldom, if ever, used in American building work. For two-rivet connections the minimum size of angle that can be used is usually in excess for the small stresses obtained. Thus, much of the seeming severity disappears in actual practice.

It will be seen from the foregoing that there are many points of similarity as well as of dissimilarity between the Belgian specification and American practice. These points are worthy of consideration when it comes to writing a specification that can be truly called American.

R. FLEMING,
New York City, Feb. 3. American Bridge Co.

More About Air Valves on Conduits

Sir—I want to take a good hard friendly wallop at the article in *Engineering News-Record*, Jan. 13, p. 76, without casting any reflection on the author, H. L. Thackwell, who is evidently entitled to credit for being thoughtfully interested in his work and for a very laudable desire to assist in the improvement of existing engineering formulas.

The discharge through an 8-in. valve under a head that (from the description of the apparatus proposed) cannot be greater than 15 ft., will be relatively so small that the conditions in the vertical 15-ft. length of 3-ft. pipe will not at all approach the ordinary conditions for which a 3-ft. pipe must be designed, and there could certainly not be a satisfactory test of a 6-in. air valve.

A 6-in. air valve would probably be safe equipment for a 60-in. pipe under fairly severe service. Our test would roughly reproduce the following service conditions: A disturbance in a pipe line which would cause a displacement, or a necessity for air supply equivalent to approximately 9 sec.-ft., which means a velocity of a little more than 1 ft. per second in a 3-ft. pipe and a little less than 0.5 ft. per second in a 5-ft. pipe. Not a very satisfactory test.

The principle of the proposed apparatus appears to be all right, and it might do the work if made very large and costly, but the results would be of little value. Reliable empirical formulas are not made that way. They are based on years of actual successes and actual failures. It is not generally possible to predict emergency conditions with such

accuracy that they can be dependably produced in the testing laboratory.

An air valve is a comparatively inexpensive fitting which protects in some cases thousands of dollars' worth of property. As such its size and cost are not properly susceptible of reduction to a minimum. Use first-class air valves and be liberal with them the same as you would be liberal with fire hose in a frame building.

In time there will no doubt be a better formula to aid the designer in choosing air valves; but this equipment must always be regarded as a protective device, not to be tampered with. As Mr. Hazen states in his letter in *Engineering News-Record*, Jan. 20, 1921, p. 134, the old rule is not so bad, and is safe enough if used with judgment in cases where extreme service may be expected.

Seattle, Wash, Feb. 2. CHARLES P. DUNN.

[Proof of the foregoing letter was sent to Mr. Thackwell. His reply follows.—EDITOR.]

Sir—I would infer from Charles P. Dunn's criticism (above) of my article on "Air Valves for Pipe Lines" that he has not thoroughly understood the purport of the suggested apparatus. My intention was to outline a form of equipment suitable for college thesis work. Realizing that funds for such work are not as readily obtainable by students as by professional research workers, I allowed economy to dictate the details of the equipment.

Since the largest quick-opening gate valve in my catalog was 8 in. I used that in the illustration. A balanced needle-valve, of larger size, would of course give a wider range of discharges, but would be very much more expensive.

At the time I made the drawing I had in mind a range in size from 20 to 36-in. pipe. This would give a theoretical velocity range from 4.95 to 1.53 ft. per second. A formula based on such sizes could no doubt be used with safety on larger pipes.

Mr. Dunn does not seem to grasp the fact that a 6-in. cluster valve is a very different article from a 6-in. single valve. These cluster valves are so arranged that the size or opening can be made to equal that of a 2 in. single valve, and as I tried to illustrate it, the valves would be blocked up, and only the size desired would be used on any single experiment.

Mr. Dunn's statement, "reliable empirical formulas are not made that way; they are based on years of actual successes and actual failures," is certainly a radical departure of opinion from that held by many able experimenters, who have given us the vast numbers of formulas, which have been based upon experiment and plotted data. The real tools of the engineer today are fundamental laws, all of which have been arrived at by observation, and that generally in the testing laboratory.

I recently designed a 33-in. pipe line, in which the cost of air-valves alone exceeded $20,000, which is not an inconsiderable item to the man who has to pay the bill.

In my own experience I have found rule of thumb methods very costly, which confirms my views that more reliance should be placed on experimental data.

Denver, Col., Feb. 19. H. L. THACKWELL,
Hydraulic Engineer.

Defects of Long Beach Dome Design

Sir—Referring to the article in your issue of Feb. 17, p. 294, describing the failure of a concrete dome at Long Beach, Cal., it seems incredible that a design so faulty should have passed along the entire line from the designer to the structural-steel detailer and contractor without someone's rising up and proclaiming that he at least would assume no responsibility for the results. As it is, it appears that the whole line must share the responsibility.

The article does not specifically call attention to the worst points in this design. The fact that this construction was designed for dead load only is by no means the worst point. If there were no other bad points, it would undoubtedly be still standing, since the evidence does not show that there was any live load of any character. If the sketch in your article is an exact representation of the shop drawing, the very worst point is the joint between the 10-in. and the 12-in. channels of the top chord of trusses *C* and *D*. This joint could not withstand the top-chord stress unless there was a definite brace directly at this point. Without this brace, it would buckle even if the two adjacent panel points were braced. If the channels are not faced, the gusset plate for a depth of 12 in., which is all that can be counted, would be under a stress of 32,000 lb. per sq.in. due to dead load only.

The next worse point is the use of channels for the top chord which are very deficient in lateral strength, and would buckle under the dead-load stress, considering the length between trusses *D* and the 15-in. beams. The next worse point is considering that the 15-in. beams and trusses *D* constitute bracing of any character at all. They certainly do not. The anchorage of beams is not sufficient to resist lateral pull of any amount. Even if the beams are capable of resisting lateral pull, their connection to trusses *C* and *D* is at the wrong point. It is also quite certain that a square placed diagonally into another square does not constitute bracing of any character.

The next worse point is the connection of trusses *C* and *D* to the columns. As far as the detail shows, the connection consists of six ¾-in. bolts or rivets through the bottom flange of two 9-in. channels. The resistance at right angles to the truss would be about 40,000 in.-lb. Assuming a height of column of 35 ft. and allowing for an anchorage at the bottom equal in strength to the top connection, the connection would break under a lateral force of 1 lb. per sq.ft. on a vertical surface from the bottom of the truss to the lave of the dome. Structural steel columns should have been used and carried to the top chord of the truss. To provide additional stiffness in the columns, they could have been encased in concrete.

Some years ago, in relation to a certain university building, I was asked why the university did not have the engineering students design the structural part of the building. My reply was that although the students could probably work out the stresses, they were not acquainted with the various pitfalls which lie between the stress sheet and the completed building. If the design described in your article is the result of employing experienced engineers, it is about time to try the university students.

Detroit, Feb. 24. J. T. N. HOYT,
Chief Structural Engineer for Albert Kahn, Architect.

Concrete Dome in Long Beach Failure Was Overstressed

Sir—In connection with the article by Edward R. Bowen in *Engineering News-Record* of Feb. 17, p. 294, on the failure of the steel truss supports of the dome of the Long Beach Christian Church, no mention has been made of the extremely weak and inadequate design of the concrete dome.

We had occasion, after the failure, to make an investigation of the concrete and steel design for the Industrial Accident Commission of California. The critical stresses in the dome were found at the spring line, located 90 in. above its base. At this point there is a bending moment due to the line of pressure being eccentric to the center line of the arch ribs by 10 in., a moment due to the horizontal thrust, and an axial load due to the weight. These combined produce a stress in the extreme fibers on the compression side of the ribs in excess of 2,000 lb. per sq.in. under dead load only.

It is possible that the initial cause of the failure was the buckling of the arch ribs at the spring line due to the thrust. The impact on the trusses of the falling mass of the dome, weighing approximately 200 tons, might have increased the highly strained condition of the top chords of the trusses *C* and *D* and caused them to buckle. It was reported that the artificial stone covering of the dome was being laid at the time of failure.

Had more details of the dome been published with the article the weakness at the spring line would have been apparent. FRANK A. JOHNSON,

San Francisco, Feb. 23. HARRY W. BOLIN,
Asst. Engineers with H. J. Brunnier, Consulting Structural Engineer.

Antioch Plan Omits Public Service Training

Sir—Admirable as is the "Antioch Plan" outlined by President Arthur E. Morgan in *Engineering News-Record*, Jan. 20, 1921, p. 108, it is remarkable that the author makes no specific mention of training for administrative public service. While the idea of training to carry ultimate responsibility is stated and re-stated, it would appear from the author's illustrations and from the outline of the proposed practical work, that it is the industrial field that the college will primarily serve.

The shop atmosphere appears to pervade President Morgan's article; indeed, he finds it desirable to liken an educational institution to a factory. He considers the technic of administration which is to be transmitted to Antioch students as including the "ability and habit of analysis of a job into factors that count for its success, such as cost analysis, plant operation, financial management, personnel organization, buying, salesmanship, development of morale, production methods, and analysis of supply and demand." As work at Antioch will center around training for proprietorship and administration, "it is planned to build a factory building on the campus and to locate there a number of small industries." The administrator, of which the author speaks, "sees all phases of industry." These and many other references to the industrial field give the reader the impression that Antioch is to be primarily a "vestibule school" to the manufacturing and commercial field.

Since so much that is commendable is planned for the revivified institution, it is to be regretted that the author did not give some special indication that Antioch proposes to train men whom the United States, as well as Canada, needs most of all—those who can direct with skill, efficiency and devotion the countless enterprises of the people. Fortunes are not to be made in such work, but the present writer believes it to be the duty of educational institutions offering technical courses to point out the magnificent opportunities in the public service and to prepare young men to undertake the administration of works departments, or indeed of all departments of towns and cities; the bureaus, services and departments of governments; the work of public service commissions, and of such institutions as Antioch itself.

C. R. YOUNG,
Associate Professor of Structural Engineering, University of Toronto, Toronto, Canada.

Toronto, Canada, Feb. 14.

Sir—I find little to take issue with in the foregoing letter by C. R. Young. The article in question was reduced from a considerably longer manuscript and suffered in the reduction by the elimination of emphasis upon the development of social and moral purposes. The fact is, the writer's interest in Antioch would be considerably less did he not see there an opportunity for helping young people to define their social, economic and moral purposes, and to put them in the position of economic independence, where practical expression of those purposes will be economically feasible.

The one point which should be made clear is that Antioch is in no sense to be simply a vestibule school to the manufacturing and commercial field. Technical and professional education has suffered from the limited attention it has given to general cultural education. No young person will be able to graduate from one of the vocational courses at Antioch unless, in addition to his vocational training, he has secured the fundamentals of a liberal education which enables him to have an intelligent view of his place in society and his inheritance of wisdom and culture from the past.

As to undertaking a course for the preparation of young men and women in public service, the combination of a liberal education and of a general vocational course aimed to develop administrative capacity will be no mean preparation for public service. As to training for specific public duties, the absence of such courses is simply due to the fact that Antioch cannot cover the whole field. The attendance will be limited to not more than 600 students, and the best work can be done by limiting courses to a few that can be adequately covered.

Antioch will have performed its greatest service if it is a successful demonstration of a general principle of educational method. With the success of Antioch the way will be opened for many other small colleges to undertake work in a specific field, instead of dissipating their energies by covering many fields in a superficial manner. The way to success for the small American college is through diversity, and it would seem entirely feasible for some institution to take as its peculiar work preparation for social and public service of specific kinds.

Seldom a day passes without a suggestion reaching me concerning some course in study which is "so fundamentally necessary to social welfare that it ought by all means to be included in the Antioch program."

Yellow Springs, Ohio, March 2.

ARTHUR E. MORGAN,
President Antioch College.

Sir—The thought that comes to me in reading Mr. Morrison's article on "The Antioch Plan; What to Teach" (*Engineering News-Record*, Feb. 24, p. 349) is that if his advice is good for the engineering schools it should be equally valuable to the other professional schools. I therefore suggest to the medical schools that they teach their students of the organization and duties of the public health service; of the organization, operation and financing of hospitals; cost accounting and bookkeeping; how to be pleasant and courteous to patients; how to vote on election day; deportment at dinner parties; and a little about a few diseases, such as bad colds and stomach ache; and a little more about surgery, enough, say, to tie up a sore toe. After this, furnish them with a complete bibliography of medical and surgical books, and, as I understand the plan, everything should go along happily.

Under this plan, it seems that we will train our men to be executives, financiers and captains of industry; and will be relieved of the necessity of training them to become engineers. Then, too, it would do away with so many irksome courses, such, for example, as calculus and mechanics. All that the graduate would have to do would be to look up his problems in the handbooks. It would surely enormously simplify the present program, and I vote for it with three rousing cheers. Also, my students tell me that they are heartily in favor of Mr. Morrison's suggestions; particularly those of them who are now wrestling with moment of inertia. They assure me that they see no earthly reason for multiplying dm's by r^2's; and that they would be much obliged if I would "junk" the stuff and give them a course in table manners. The ayes have it, Mr. Editor.

L. S. LE TELLIER,
Professor Civil Engineering, The Military College of South Carolina.

Charleston, S.C., March 2.

"Let Engineers Be Heard"

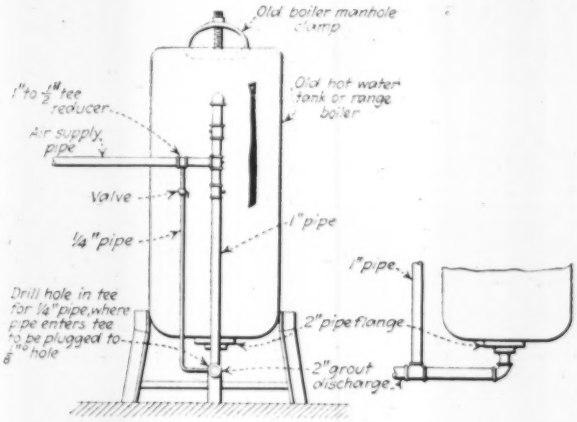
American engineers to the number of many thousands, under the leadership of Mr. Hoover and others, are taking concerted action to impress upon the government and the people of America the fact that it is high time that the counsel of engineers was taken as well as the advice of politicians in technical affairs. The war, it has been said and seen, was an engineers' war; but at all times and in all places partisan political affiliation was allowed to interfere with its most effective prosecution. Politics, nominally adjourned, was given right of way over disinterested policy. Our major public utilities, in making large tracts of desert land arable, in developing projects of canalization and inland waterways, in utilizing water-power for hydro-electric developments, in the proper and equitable exploitation of Alaska and in many other connections, demand the best brains of experts, not the casual attention of politicians with axes to grind, fences to mend and feudal armies of heelers to maintain. In the service of the country already are many excellent engineers who have admirably performed. They are entitled to the guidance of those who are familiar with the problems they are facing. They must not be victimized and their work must not be nullified by the ignorance and incompetence of directors whose personal power and private gain come before the nation's good.—Philadelphia Public Ledger.

HINTS FOR THE CONTRACTOR

Hot-Water Tank Makes Grout Machine for Repairing Chilean Dam

By Donald G. Coombs
Civil Engineer, Seattle, Wash.

During the winter of 1919 severe floods carried away a considerable portion of the downstream apron of a concrete diversion dam across the Rio Cachapoal at Chacayes, Chile. This dam was at the intake of an 8-mile power canal furnishing water for the Coya generating station of one of the large American mining and smelting companies in Chile. At low water several months later this apron was rebuilt and extended and as a precaution against any possible flow of water under the dam and apron it was decided to grout the gravel foundation on which it was built.



TWO VIEWS OF RANGE BOILER RE-FITTED AS GROUTING MACHINE

With this in mind 2-in. pipes had been embedded in the apron the entire length of the dam, extending well into the gravel foundation.

With a portable gasoline-driven air compressor the only available equipment, the general foreman in charge evolved the idea embodied in the accompanying sketch. As can be seen it is simply an ordinary hot water tank, or range boiler, of approximately 50-gal. capacity. For charging the machine an air-tight door was made of an old boiler man-hole clamp. The grout was mixed in a small steam driven mixer after the sand had been carefully screened, but to insure an absolutely clean grout it was further screened, after mixing at the grout machine.

To prevent any possible clogging of the discharge pipe when the rather thick grout was used at the beginning of a hole, the air by-pass was installed as shown on the attached sketch. Where this ¼-in. pipe entered the main discharge pipe it was plugged to not over an ⅜-in. hole, and this volume of air kept the grout sufficiently agitated to prevent plugging. After the valve in this by-pass line was properly set it was left open during the run.

As many as 400 sacks of cement were used in one hole. With 85 lb. at the compressor no trouble was experienced in filling all voids in the foundation and for considerable distances on each side. All the material necessary for building this grout machine are found on any ordinary construction job, and the above experience showed it to be as efficient as any high-priced standard grout machine.

Frank B. Prescott was superintendent in charge of repairs, John Peraldo was general foreman, and the writer was office engineer.

Anchored Barge and Timber Spuds Hold Cofferdam in Swift Water

By George W. McAlpin
Point Pleasant, West Virginia

In building box-type cofferdams in the Ohio river, great difficulty is often experienced in holding the framing and sheeting in place until they can be filled, due to the swift current. In most cases guide piling can be driven, against which the cofferdam leans until filled, but, in some cases, the swift current has scoured the river bed to such an extent that there is practically no material to hold piles, only a few feet of deposit being left upon the rock. To overcome this difficulty and to hold the cofferdam the following arrangement has been used by the superintendent for the National Contract Co.

A cluster of piling is first driven 300 ft. or more upstream from the line of the cofferdam, or far enough to secure a good penetration. From the cluster, or from an anchor if a cluster is not driven, lines are led to a barge made fast in line with the lower side of the cofferdam. Spuds, made from 14 x 14-in. timbers, iron pointed, are then dropped over the side of the barge, the force being sufficient to cause the points to penetrate the deposit and go several inches into rock. The upper ends of the spuds are held by lines, so that they will remain in a vertical position. The cofferdam is then assembled and when lowered to place slides down the spuds.

After the sheeting is placed and the cofferdam filled sufficiently to hold it, the spuds are pulled, and the barge moved ahead for another section. In this manner a length of Cofferdam equal to the length of the barge used can be built and filled without great danger of losing it in the swift water.

Plan Water-Works Now

Because of the present marked depression in industrial activity and the widely distributed condition of unemployment George W. Fuller, consulting engineer, urged on members of the Indiana Sanitary and Water Supply Association at their recent meeting immediate planning and construction of water-works. The prices of both material and labor are commencing to show substantial reductions and contractors are anxious to undertake work at reasonable figures. During the present period of industrial stagnation, continued Mr. Fuller, progressive cities will proceed with the rehabilitation of water-works and other public improvements. This policy will serve in large measure to relieve unemployment conditions and to stabilize the industrial system of the country.

NEWS OF THE WEEK

New York, March 17, 1921

Engineers Discuss New York Port Report

Proposal of Deep Tunnel Loop and Automatic Electric Operation Criticized in Discussion

The report of the New York-New Jersey Port and Harbor Development Commission was discussed at the regular business meeting of the American Society of Civil Engineers in New York, March 2, 1921, following a paper by B. F. Cresson, Jr., chief engineer of the commission, embodying a presentation of the commission's report. The engineering plan for developing the port, as recommended by the commission, was made public Jan. 24, and reported in abstract in *Engineering News-Record*, Jan. 27, p. 182, and Feb. 10, p. 271. The plan would make the harbor a railhead port, with the exception of Manhattan, in which local distribution and collection of freight would be conducted through twelve or more zone-warehouse terminals served by a deep tunnel, "automatic-electric" railroad in the form of a loop, with two tunnels under the Hudson River, connecting with a joint transfer yard on the Hackensack Meadow in New Jersey. Mr. Cresson said that the important thing now is to obtain a treaty between the two states, constituting a port authority, and that the plan itself will probably be subject to considerable revision. In regard to the "automatic-electric" system, Mr. Cresson said that the automatic feature is something that can be developed from manual operation and experimental trial and that this feature is the important one of the system.

T. Kennard Thomson, consulting engineer, New York City, opened the discussion with criticism of the deep tunnel system of the automatic-electric railroad and of excavations necessary below the proposed terminal buildings as dangerous to the foundations of adjacent buildings and subways. A statement by Gustav Lindenthal was read embodying criticisms of the commission's recommendations in comparison with the Hudson River bridge plan, as outlined elsewhere in this issue.

B. F. Fitch, president of the Motor Terminals Co., New York and Cleveland, and J. P. Hallihan, consulting engineer, New York City, suggested serious consideration of early building of units of automatic-electric zone terminals to be used as temporary distribution and reconsolidation points for motor-truck distribution and collection in Manhattan, carrying demountable unit container bodies between New York and New Jersey rail transfers over existing ferry routes, which, the commission's report indicates, have sufficient surplus capacity for the service. It was stated by Mr. Fitch that a large measure of immediate relief, with release of Manhattan railroad pier stations, could be accomplished by such a program pending the building of the tunnel system. Mr. Hallihan said that such a program would very probably point the way to the inclusion of store-door delivery in the commission's plan.

G. W. Kittredge, chief engineer, New York Central Lines, closed the discussion by urging the society's support in development of relief for the port of New York.

Federation Urges Reorganization of N. Y. State Government

Any corporation or business interest would go into bankruptcy if its affairs were conducted as are those of the State of New York, the committee on New York State government reorganization of the Federated American Engineering Societies declares in a report to the chairman of the joint judiciary committees of the Senate and Assembly. The report is signed by the three members of the committee who were appointed by Herbert C. Hoover. They are H. deB. Parsons, chairman; Paul G. Brown, and Lewis B. Stillwell.

The work of this committee, which is co-operating with the New York State Association in plans to reorganize the state government by constitutional amendments, is part of the program of public service entered upon by the American Engineering Council, the federation's governing body.

The committee urges the passage of the three state reorganization amendments involving a consolidation of state departments, an executive budget system and a four-year term.

"A department of public works," says the committee, "would be a most important division of the state government. The same can be said of a department of conservation. A large proportion of the expenses of the state are incurred for public works. Both engineering and architectural functions should be grouped under the department of public works where they can be systematically and efficiently managed without duplication and waste of public funds. Great economies can be attained through the departments of public works and of conservation. If large enterprises are to be handled efficiently, it is of vital importance to have one man in authority with respect to policy, finance, labor, materials and other controlling items, who can be reached without delay. It is essential that those in actual management of detail work should have ready access to this man."

Minnesota Societies Form Engineering Federation

Architects Join in State Movement—Ten Organizations Represented—Constitution Ratified

The Minnesota Federation of Architectural and Engineering Societies was organized at a meeting in Saint Paul March 11. Adolph F. Meyer, president of the Minnesota Joint Engineering Board, presided. The board was instructed by resolution to act as the first board of directors of the federation, to take over the *Bulletin*, published heretofore by the five state societies, to employ a secretary-editor, and notify all member societies that the federation was now in existence and prepared to function in the interests of engineers.

The federation consists of the following ten societies and branches of national organizations: Minnesota Surveyors' and Engineers' Society; Minnesota Chapter, American Institute of Architects; Minnesota Chapter, American Society of Heating and Ventilating Engineers; Northwestern Section, American Society of Civil Engineers; Engineers' Club of Minneapolis; Engineers' Society of St. Paul; Minnesota Section, American Institute of Electrical Engineers; Minnesota Section, American Society of Mechanical Engineers; Engineers' Club of Northern Minnesota; and the Duluth Engineers' Club. These organizations had previously ratified the constitution of the federation.

No Individual Members

The federation has no individual members, membership being vested in the various societies. Each society pays dues according to the number of its members, but there will be no duplication of dues on account of duplicate membership. Each society has two representatives on the board of directors. The board has full power to act on any matter affecting the two professions, and no society can take action on state-wide matters in contradiction to that taken by the board. Jurisdiction in purely local matters is left undisturbed.

At a banquet in the evening W. B. Powell, president of the Engineering Society of Buffalo and member of the executive committee of the American Engineering Council, outlined the formation, aims and purposes of Federated American Engineering Societies, urging the five local societies to seek charter membership separately. Action has been deferred by all, except the Duluth Engineers' Club, waiting the formation and action of the State Federation on this matter.

Spring Valley Water Co. Purchase Fails at San Francisco

At a special election, March 8, in San Francisco 42,900 votes were cast for and 31,000 against the purchase of the water-works system of the Spring Valley Water Co. As a two-thirds majority was necessary to approve the proposal, the plan failed to carry.

The vote was on the question of purchase at a value of $37,000,000 fixed by the Railroad Commission and accepted by the company. Funds were to be provided by bonds which would not be included in the 15 per cent limit of bonded indebetedness set by the city charter. The value was fixed as of Jan. 1, 1920, and to this was to be added the appraised cost of improvements to date, these not to exceed $1,000,000. This price included 61,560 acres of the total of 87,437 acres of land owned by the company, the selection of areas desired by the city having been made by the city engineer and other authorities.

A city-wide campaign for the purchase was conducted by city officials for weeks previous to the election. In fact, city officials stated after the election that few projects in the city's history have been so well advertised as the purchase of the Spring Valley system which was backed by the city administration and the public press. There was very little organized opposition to the measure, practically all of the civic, social and labor organizations of the city having officially endorsed the purchase.

James Rolph, mayor of San Francisco, commenting on the defeat of the proposal, said: "Let us not forget that the purchase of Spring Valley is an ever recurring problem which we must solve for our own welfare." Supervisor Ralph McLeran pointed out that the Spring Valley Water Co.'s application to the Railroad Commission for an increase in rates, which is now pending, will doubtless be granted and the citizens may expect an increase of rates within 90 days. This could have been avoided, he said, had they voted for the purchase.

In the Board of Supervisors, James B. McSheehy was practically the only member actively to oppose the purchase. He based his opposition on the grounds that the price asked was too high. "We are now asked $10,000,000 more than in 1910 and nothing is allowed for depreciation," Mr. McSheehy said. "By buying Spring Valley," he added, "the city would find itself with a bonded indebtedness of $150,000,000, or 25 per cent of its assessed valuation, which is $600,000,000. These facts were told at 42 meetings."

This is the third time the proposal to purchase the Spring Valley system has failed to receive the necessary two-thirds vote. The previous elections were held in 1910 and 1915. A summary of the water situation in San Francisco by J. Waldo Smith appeared in *Engineering News-Record* Feb. 7, 1921, p. 305.

Overloaded Wall Buckles

Storage of waste paper stock in a warehouse at the foot of Center St., Newark, N. J., overloaded the floors of the building to such an extent that the entire rear wall, five stories high, buckled outward on March 3. The owner of the building had warned the tenant that he was overloading the floors, but took no further steps to safeguard the property, being protected by a lease clause calling for all damage to be repaired by the tenant. The city building authorities were not informed of the overloading until after the accident.

New York Governor Wants State Water Power Control

In a message to the Legislature on March 11 Governor Miller of New York recommended that a state water power commisssion be created, consisting of the attorney general, the state engineer, and the conservation commissioners, to have power over the state waters quite comparable to the power that the Federal Water Power Commission has over federal waters. In other words, the Governor recommends for the State of New York a policy of private operation and limited term ownership under state control.

The commission he proposes would have power of licensing and duties of examination and inspection and control of power plants, but the regulatory powers as to rates and service would be vested in the State Public Service Commission. The Governor furthermore stated that in his opinion the Federal Water Power Act is unconstitutional in so far as it relates to the federal government's claim to control the boundary waters, such as the Niagara River, and he has instructed the attorney general of the State of New York to take legal action in the matter. Legislation to carry out the Governor's program will soon be introduced in the New York Legislature.

Injunction Against Furnishing Impure Water Issue

Following action brought by the attorney-general of Pennsylvania at the instance of Edward Martin, state commissioner of health, the Dauphin County Court on Jan. 7 gave the Tri-Borough Water Co., which operates in Tarentum and Brackenridge Boroughs, ten days to show cause why it should not be restraind from supplying water alleged to be inferior. In the bill in equity filed by the attorney-general it was charged that the water for some time past has been "impure, detrimental to the public health and the cause of disease and mortality, in that said water contained and now contains in large quantities the germs of typhoid fever." The bill also states that the company was notified Nov. 23 to discontinue furnishing the water notwithstanding which no improvement was made in the quality of the water delivered.

How Federal-Aid Road Bill Was Defeated

(*Washington Correspondence*)

Friends of the federal-aid road policy are at a loss to understand the reasoning of those who are claiming victory for the Townsend policies. The recent vote in the Senate which blocked the federal-aid bill was not on the bill itself but on the question of the suspension of the rules. To suspend the rules requires a two-thirds vote. Considerably more than a majority of the senators voted to suspend the rules, near the close of the session when there was every desire to avoid taking up legislation which would consume considerable time.

That so many voted under those conditions to suspend the rules is held to be most encouraging to those who would see a continuance of the existing policy. Forty-two senators voted for suspension, while 33 voted against such action. Had the vote been on the federal-aid bill itself it is believed that the majority would have been greater by at least two or three votes.

Certainly those who voted to suspend the rules could be relied upon to vote for the federal aid bill whenever it comes up.

How Senate Voted

Owing to the wide interest in the vote, there is given below the names of the Senators who voted to suspend the rules:

Ashurst, Arizona; Beckham, Kentucky; Capper, Kansas; Chamberlain, Oregon; Culberson, Texas; Curtis, Kansas; Dial, South Carolina; Fletcher, Florida; Gay, Louisiana; Glass, Virginia; Gooding, Idaho; Gore, Oklahoma; Gronna, North Dakota; Hale, Maine; Harris, Georgia; Harrison, Mississippi; Heflin, Alabama; Henderson, Nevada; Hitchcock, Nebraska; Jones, New Mexico; Kellogg, Minnesota; Kendrick, Wyoming; McKellar, Tennessee; McNary, Oregon; Myers, Montana; Overman, North Carolina; Phelan, California; Pittman, Nevada; Ransdell, Louisiana; Reed, Missouri; Sheppard, Texas; Simmons, North Carolina; Smith, Arizona; Smith, Georgia; Smith, South Carolina; Stanley, Kentucky; Sterling, South Dakota; Sutherland, West Virginia; Swanson, Virginia; Trammell, Florida; Underwood, Alabama; Walsh, Montana.

Some of the senators in the above list will not be members of the new Congress, but it is understood that the incoming senators hold the same views as did their predecessors. It will be seen that the south and the west are almost solidly in favor of the continuance of federal aid. Since those two sections have a majority of the votes in the Senate, probabilities point to a continuance of the federal-aid policy. The majority in the House, which has gone on record for that policy, is overwhelming.

It is admitted by the advocates of federal-aid that the Sells bill is not entirely satisfactory and it is believed that the measure which will be presented at the next Congress will contain important revisions of the existing policy. It is expected that the bill will contain strict requirements in the matter of maintenance of federal-aid highways.

Indiana License Bill Law

Governor McCray March 10 signed the Indiana engineers license bill making it a law. The law is founded principally on the model proposed by Engineering Council modified by a few features promulgated by the American Association of Engineers, the Indiana chapters of which are responsible for the passage of the bill.

Chicago Engineers Organize

Consulting engineers of Chicago who specialize in designing and directing the installation of mechanical, electrical and sanitary equipment for buildings have formed an organization under the name of the Chicago Association of Consulting Engineers. H. A. Durr, 123 W. Madison St., is secretary.

Mechanical Engineers Announce Spring Meeting

The American Society of Mechanical Engineers will hold its spring meeting at the Congress Hotel, Chicago, May 23-26. Sessions are planned by the professional sections on aeronautics, fuels, management, material handling, machine shop, power, forest products and railroads.

New York City Opposes Port Treaty with New Jersey

On March 11 the Board of Estimate of New York City adopted a resolution, presented by Mayor Hylan, opposing the port treaty between the states of New York and New Jersey. The resolution declares that the proposed plan is contrary to the federal constitution, the constitutions of the two states and the public policy of the city of New York.

The resolution states that the treaty "provides for the organization of a corporation without time limit for its franchises, to be known as the Port Authority, with power to acquire and operate railroads, surface and subway, and terminals, and to make rules and regulations with the force of statutes, and fix charges without limit, and generally to control the methods of merchandise in said port district."

The Board of Directors of the Brooklyn Chamber of Commerce in a report made public March 13 came out in opposition to the proposed port treaty between the States of New York and New Jersey in its present form.

The reasons given were that the treaty was inadequate to bring about a unified port development, that it would not co-ordinate the many authorities now functioning in the port.

On March 9 George H. Stege, president of the West Side Taxpayers' Association of New York City, sent a letter to Commissioner of Markets Edward J. O'Malley vigorously protesting against the plan of the bi-state commission, stating that it would destroy the present primary wholesale market and require New York food wholesalers to take their deliveries in the Jersey meadows.

Form Engineers' Exchange

John Ericson, former city engineer of Chicago, now consulting engineer for the city, J. W. Pearl, civil engineer, and other consulting engineers have founded the Engineers Exchinge, Inc., which is an association of consultants for the collection and distribution of information for engineers and clients. The objects of the association include the following features: To provide a reference library and a central office for conferences; to assist clients in negotiations for experienced engineering service; to serve as adjusters; to address officials, discuss the value of engineering service and present the merits of co-operation by members regularly engaged in the design and construction of specific parts of the project under consideration; to discourage "free" service and to uphold the standards of practice. Other members of the board of trustees are John P. Cowing, Chicago; M. L. Jones, Benton Harbor, Mich., and A. L. Burridge, Crystal Falls, Mich.

Bridge Design Ordered Modified

Recommendations that an additional bond issue of $1,000,000 to permit the Belle Isle bridge to be built according to the original or commission design be submitted to referendum vote next month were defeated by the Detroit City Council on March 8, and the prospects that the original design may be carried out have thereby been practically destroyed. The council instructed the supervising engineers for the bridge, the firm of Esselstyn-Murphy, to revise the official plans, making such modifications as will bring the cost within the balance of approximately $2,500,000 remaining of the original $3,000,000 approved by popular vote. The principal modifications are a substitution of fill for retained approaches and reduction of width of the carrying elements of the structure, the sidewalks to be cantilevered beyond the outer faces so as to maintain the full deck width. It is expected that the revised plans will be completed early in April.

In connection with the same undertaking a request has been received by the council from W. H. Adams, representing Daniel B. Luten, who prepared the plans of a reinforced-concrete arch bridge recently submitted to the council for the Belle Isle site, that the council act favorably upon a petition laid before it by the Detroit chapter of the American Society of Civil Engineers that the original Belle Isle bridge commission be reappointed and charged with the responsibility of passing upon the arch plans. It is represented that all the criticisms of the arch plan that have been presented to the council have been made without detail knowledge of the plans condemned, and that most of the arguments were directed against a method of securing plans rather than against the designs. Up to the present the council has not taken action on this request.

Plan to Bridge Columbia River

Seattle business men are planning to raise $75,000 toward the $500,000 required in the building of a toll bridge across the Columbia River between Kennewick and Pasco on the Inland Empire highway. The bridge would form a main link between eastern and western Washington, and is expected to provide heavily increased trade for Puget Sound ports, particularly Seattle.

Two Nominations to I. C. C.

On March 11 President Harding nominated former representative John J. Esch and Mark W. Potter to the Interstate Commerce Commission. The nominations were reported favorably by the Senate Interstate Commerce Committee, but final action was not taken. Mr. Potter was one of the three nominated by President Wilson, but not confirmed by the Senate.

Civic Tour to Europe

With Dr. John Nolen, town and city planning specialist, of Cambridge, Mass., as the executive head of the party, a civic tour of Europe is being organized to study business, social and economic conditions. The party to which engineers and their families will be welcomed will leave New York City June 7. Plans have been made for an itinerary to include England, Scotland, Belgium, Germany, Austria, Italy, Switzerland and France. The cost from New York through Paris from June 4 to Aug. 3 will be $940, exclusive of return transatlantic passage, which costs $120 or more.

For further information address J. L. Crane, Jr., Robinson Hall, Harvard University, Cambridge, Mass.

Engineers to Review Los Angeles Sewage Disposal Plan

The proposed new sewage disposal project for Los Angeles, Cal., outlined in *Engineering News-Record*, Feb. 24, p. 331, is to be reviewed by a board of engineers consisting of William Mulholland of Los Angeles, George W. Fuller of New York, and George C. Whipple of Cambridge, Mass., and New York City. As stated in the article cited, the Los Angeles sewage treatment project provided for fine screens of the drum type, with discharge of the effluent into the Pacific Ocean. It has since been reported that it was also proposed to chlorinate the effluent.

A bond election in March of this year was contemplated to vote $12,850,000 for the sewage-works and for a new outfall and branch trunk sewer. The Los Angeles Chamber of Commerce and other local and civic organizations requested the city council to employ a board of engineers to review the plans of John A. Griffin, city engineer, and W. T. Knowlton, engineer of sewers. The city council in turn requested the American Society of Civil Engineers and the American Association of Engineers to suggest the names of ten or twelve qualified engineers from which

the council might select two men to serve with Mr. Mulholland as a third member.

Rivers and Harbors Bill Now Law

The Rivers and Harbors bill authorizing the expenditure of $15,000,000 for maintenance of present works and the prosecution of projects already authorized, under the direction of the Secretary of War and the supervision of the Chief of Engineers, was approved March 1. The bill also makes $250,000 immediately available for examinations, surveys and "contingencies for rivers and harbors for which there may be no special appropriation," but no part of this sum is to be spent on projects not already authorized by law.

Federal Government Withdraws From Barge Canal

President Wilson on Feb. 28 signed the bill directing the discontinuance of operation by the Government of the fleet of barges on the New York State Barge Canal. In accordance with this act the Inland and Coastwise Waterways Service of the War Department, which had control of the operations on the canal, is offering for sale most of the fleet built for the canal, which includes fifteen self-propelled barges, thirty-eight steel cargo barges, sixteen concrete cargo barges, three wooden barges, three small tugs, and ten old wooden barges. About one-quarter of the Government fleet is being retained for operation on other waters still under its jurisdiction. Since early in the war the Government, first under the Railroad Administration and later under the War Department, has operated barges on the canal, but it recently has not had exclusive control of operations.

Coast Survey Head on Boundary Commission

Colonel E. Lester Jones, director of the Coast and Geodetic Survey, has been appointed commissioner of the International Boundary Commission, United States and Canada. He succeeds the late E. C. Barnard. Colonel Jones' appointment was one of the eleventh-hour acts of the outgoing President. The appointment has been challenged by some engineers on the ground that the treaty provides that the commissioner must be an expert geographer or surveyor. The point also is raised that this appointment should be confirmed by the Senate. Mr. Barnard's appointment was not sent to the Senate and the issue never has been raised. It is expected, however, that the Senate will look into the matter in this case.

Colonel Jones points out that little remains to be done by the commission. The work now is largely a compilation of records. The duties are almost entirely administrative and it is understood that the appointment was made largely because of Colonel Jones' record as an administrative officer, and because the Coast and Geodetic Survey virtually was the parent of the original commission. The commissionership does not carry with it compensation, and Colonel Jones is continuing as director of the Coast and Geodetic Survey.

Goethals to Study Port of Shanghai

It has been announced by the Wangpoo Conservancy Board, which has control of the port of Shanghai, China, that Maj.-Gen. G. W. Goethals has been nominated to represent America on the engineers committee which is to report on improvements to the Wangpoo and Yangtse River, including the main port of Shanghai and the adjacent ports of Woosung and Pootung. Studies of this port have been going on for a number of years, and it is expected that work will soon be commenced on projects the cost of which will probably run into millions of dollars.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The Northeastern Section, Am. Soc. C. E. at its meeting March 5, at Boston, Mass., considered the following questions: 1. Why have a section of the Am. Soc. C.E. in Boston? 2. Should the Northeastern Section confine its meetings simply to American Society matters, or include matters of general engineering interest? A committee was appointed to report on the situation.

The Philadelphia Post, Society of American Military Engineers, at its meeting Jan. 27, was addressed by Col. Mason M. Patrick (formerly major-general, Chief of Air Service, A. E. F. and chief engineer, Line of Communications, in France) on "Duties and Status of the Engineer Reserve Officer." At the Feb. 24 meeting, Col. J. Frank Barber, who was in command of the 304th Engineers in France, spoke on "Experiences of a Regiment of Combatant Engineers in Connection with an Army Offensive."

The North Dakota Society of Engineers, at its annual meeting Feb. 10-11, elected the following officers: President, R. N. Stee; first vice-president, E. R. Griffin; second vice-president, W. B. Stevenson; secretary, E. F. Chandler.

The Engineers' Club of Philadelphia, at its March 29 meeting, will consider the subject "City Paving." The advisory committee in charge of the meeting consists of Prof. Milo S. Ketchum, of the University of Pennsylvania; C. W. Pinckney, chief engineer, Borough of Manhattan, New York City and R. Keith Compton, chairman and consulting engineer, Paving Commission, Baltimore, Md.

The Annual Joint Dinner of the engineering societies of Boston, an affair of twelve years' standing, was held at the Boston City Club, March 9. It was participated in, as usual, by members of all of the engineering societies, and sections of national engineering organizations, in the city. Lewis E. Moore, bridge engineer of the Massachusetts State Department of Public Utilities, was toastmaster and the other speakers were E. J. Mehren, editor of *Engineering News-Record*, who discussed economic conditions in Europe, and Rev. McIlyar H. Lichliter, who spoke on "The Vaudeville Mind."

PERSONAL NOTES

FRANK AYDELOTTE, since 1915 professor of English Massachusetts Institute of Technology, Cambridge, Mass., has been made president of Swarthmore College, Swarthmore, Pa. Prof. Aydelotte is the author of "English and Engineering," published in 1917.

CAPT. CHARLES F. HEALEY, engineer of contracts in the city engineer's office, Chicago, has been made assistant city engineer, a position entailing executive duties as assistant to the city engineer. Capt. Healey served in the transportation department of the A. E. F. Before the war he was special investigating engineer in the city engineer's office.

V. S. PETTERSON, assistant city engineer, Chicago, has returned to his old position of chief efficiency engineer in the office of the city comptroller.

F. T. TWITCHELL has resigned from the Arizona Highway Department to engage in a survey for a proposed railroad from Ajo, Ariz., to the Gulf of California.

C. O. THURMAN of Washington, D. C., has been elected borough engineer of Jersey Shore, Pa.

FRANKLIN BAXLEY has been appointed engineer in charge of the municipal plants of Bellefontaine, Ohio.

H. L. MORISETTE, formerly with the Interstate Commerce Commission at San Francisco as junior civil engineer, has been appointed assistant engineer of the U. S. Reclamation Service at Yakima, Wash.

TOSHINAE IKEDA, chief of the civil engineer section, Bureau of Public Works, Taiwan, Japan, is now visiting the United States for the purpose of studying road building methods.

FORREST R. POLK, formerly assistant engineer Division of Highways, Illinois, has resigned to become an instructor in the department of industrial education at the Oshkosh (Wis.) Normal School.

PROF. PHILIP C. NASH, director of engineering practice, Northeastern College, has been granted a leave of absence effective April 13 in order that he may establish the co-operative method of teaching engineering at Antioch College, Yellow Spring, Ohio, under the direction of President Arthur E. Morgan.

PROF. HENRY B. ALVORD has recently been elected professor of civil engineering and will become head of the department of civil engineering of Northeastern College. Prof. Alvord has had several years of experience in civil engineering on the faculties of the Massachusetts Institute of Technology and Bowdoin College, as well as considerable professional practice. He is an ex-secretary of the American Concrete Institute.

D. T. BLACK, for the past three years city engineer of Niagara Falls, Ont., has been appointed city engineer of Galt, Ont., to succeed W. H. Fairchild, resigned.

GEORGE H. MOORE, for some years hydrographer in the city engineer's office of Seattle is now senior electrical engineer to the Public Service Commission of the State of Washington, with headquarters at Olympia.

G. W. ABBOTT, division engineer Boston division Boston & Albany, R.R., has been appointed prinicipal assistant engineer, with headquarters at South Station, Boston, succeeding E. S. Draper, deceased.

MAJOR DANIEL D. PULLEN, Corps of Engineers, U. S. A., has been instructed to report to the commanding general, Panama Canal Department, for assignment to duty with the 11th Engineers.

MAJOR JAMES W. BAGLEY, Corps of Engineers, U. S. A., has been ordered to McCook Field, Dayton, Ohio, as the representative of the Corps of Engineers in the experimental work being done in connection with the adaptation of aerial photography for mapping.

W. B. KNIGHT, division engineer Albany division Boston & Albany R.R., has been transferred to the Boston division, with headquarters at South Station, Boston.

E. K. MENTZER, supervisor of track sub-division 1 Boston & Albany R.R., has been appointed division engineer Albany division, with headquarters at Springfield.

E. L. MILES, formerly assistant chief engineer Toronto & York Roads Commission, with headquarters at Toronto, has been appointed road superintendent of Victoria County, Ont., with headquarters at Lindsay.

FRANK D. HAIN, formerly city engineer of Altoona, Pa., is now engineer for the Altoona & Logan Valley Trolley Co.

GEORGE W. OSGOOD, port engineer for the Port of Tacoma, has been appointed manager as well as chief engineer and will have charge of the operation and construction of the port facilities.

L. F. BOON, recently assistant construction engineer on the malleable foundry of the American Chain Co., York, Pa., has been appointed instructor in the department of civil engineering, University of Minnesota.

E. A. JONES, office engineer South Station, Boston, has been appointed supervisor of track sub-division 1, Boston & Albany R.R., with headquarters at South Station, Boston.

COL. FREDERICK V. ABBOT, Corps of Engineers, U. S. A., retired, has been awarded a distinguished service medal "for exceptionally meritorious and distinguished service in the organization of engineer troops and in the procurement of enlisted men for that service during the war." The citation states that "his zeal was untiring and the success of his effort marked."

JOHN H. CATON 3D, formerly major of the 33d Engineers, has been appointed director general of public works in Santo Domingo, with headquarters at Santo Domingo City, R. D., effective April 1, 1921. At present he is acting director general.

W. S. HENDERSON has resigned as county engineer of Washington County, Kan., to become city engineer of Lawrence, Kan.

V. B. FREDENHAGEN, formerly resident engineer on Federal Aid Projects Nos. 44 and 45 in Saline County, Kan., has been appointed county engineer of Jewell County, Kan., with headquarters at Mankato.

M. L. DEAN, diking engineer of Walla Walla County, Wash., has been named consulting engineer for the new road program to be carried out by the county.

C. K. KOPPERS, formerly superintendent for the A. S. Hecker Co., Toledo, Ohio, is now engineer of construction for the Kellys Creek Colliery Co., with headquarters at Ward, W. Va. During the world war he served with the 17th Engineers in charge of construction of 121 miles of standard-gage track at the Montoir yards, St. Nazaire, France, and later as commanding officer Co. B, 72nd Engineers. After the armistice he was appointed adjutant to the section engineer, Base Section No. 1.

OBITUARY

CALVIN TOMKINS died March 13 in New York City. He was born in East Orange, N. J., 1858, and was graduated from Cornell University in 1879. He was connected as managing director with several New York companies engaged in the manufacture of building materials, among which were the Tomkins Cove Stone Co. and the Bonner Brick Co. From 1910 to 1913 he was commissioner of docks and ferries of the City of New York and was also a member during 1918 of the inland waterways commission of the U. S. Railroad Administration. He was a specialist in port facilities work.

COL. EUGENE W. VAN C. LUCAS, a retired officer of the U. S. Army and formerly commanding officer of the 22d Engineers, N. Y. G., shot and killed himself March 8, in New York. He was born in 1864 and was graduated from the U. S. Military Academy at West Point in 1887. After one year's duty with the First Artillery he was transferred to the Corps of Engineers and after two years at the Engineer School of Application and two years as assistant instructor of military engineering at West Point, he was assigned to river and harbor work. In the Spanish-American War he was chief engineer, 2d Division, 2d Army Corps in camp at Greenville, S. C. He returned to river and harbor duties in 1899, was promoted to rank of major in 1905 and in 1912 he was commissioned lieutenant-colonel and later colonel in the New York National Guard, serving as commanding officer of the 22d Engineers, N. Y. G. Colonel Lucas had complete charge of the construction of Camp Whitman, N. Y., the mobilization camp established in 1916 for the State Guard. An article describing this work appeared in *Engineering Record* July 1, 1916, p. 4. Later Colonel Lucas went to the Mexican border with the 22d Engineers. During the World War he served at Camp Meade, Md., and was retired after the armistice.

WILLIAM H. BRENTON, for the past six years field engineer for the Interstate Commerce Commission in the Pacific district, died at Jerome, Ariz., Feb. 11. He was born near Petersburg, Ind., in 1862 and was graduated from the University of Michigan in 1883. Almost continuously since that time he has been connected with the construction, maintenance, and operation of Western railroads, among which were the Chicago & Alton and the Chicago, Rock Island & Pacific. He located the Pikes Peak cog road. He also served as chief engineer for various railroad contracting firms. From 1910 to 1913 he was engaged in private practice as a consulting engineer and in 1914 was appointed field engineer, Interstate Commerce Commission, division of valuation, Pacific district and had charge of resurveys of 20,000 miles of line.

Cement and Structural Shapes Compared for 21 Years

A Remarkable Chart—1920 Was Cement's Big Year—Production 10 per Cent Above Steel, Based on 1916

Fig. 1 is a comparison of the mill prices of structural shapes and portland cement during the last 21 years. The general similarity of the two curves is striking. Except for the war period 1915-1919 they are out of phase at only one point, 1903.

The sharp rise of steel, 1915-1917, and the more gradual increase in the price of cement during that period is easily explained by the vastly superior demand for steel in war time. The mere fact that cement was able to keep on rising during a war period, when peace consumption was abnormally low, is ample explanation of its continued rise after 1917, when Government regulation of steel prices, followed by the falling demand due to the cessation of the war in 1918, brought the price of steel down rapidly to $2.45 in December, 1919—the lowest point since April, 1916.

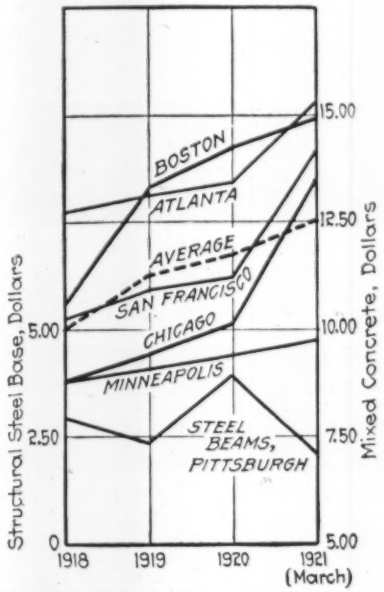


FIG. 2—PRICE TREND OF CONCRETE AND STRUCTURAL SHAPES

The cement curve is plotted from the records of the U. S. Geological Survey and the figures represent the average prices in bulk at factories. According to Ernest F. Burchard of the Geological Survey, the average prices in 1918 ranged between $1.511 per bbl. in Pennsylvania and $1.894 in Washington; with $1.22 in the Lehigh district and $1.69 in Washington in 1917. The average 1918 price for the entire country was $1.596 as compared with $1.71 in 1919 and $2.01 in 1920. The record year both in production and in price was 1920, when 100,302,000 bbl. were manufactured and 96,329,000 bbl. valued at $193,548,000 were shipped.

Spotted on the curve is the current average for the eastern mills.

With return to so-called normal, or peace, conditions, it will be extremely interesting to note whether the base curves of structural steel and cement will resume the agreement in price trend exhibited in 1900-1914.

Fig. 2, constructed from *Engineering News-Record's* monthly quotations, shows the price trend of concrete (including labor) in Boston, Atlanta, San Francisco, Chicago and Minneapolis, and the average or composite curve, as compared with the price movement of structural shapes in Pittsburgh. The same phenomenon is to be observed as in Fig. 1. Steel, the war material, had its ups and downs, whereas cement (or concrete) rose steadily—in some cases rapidly—upward.

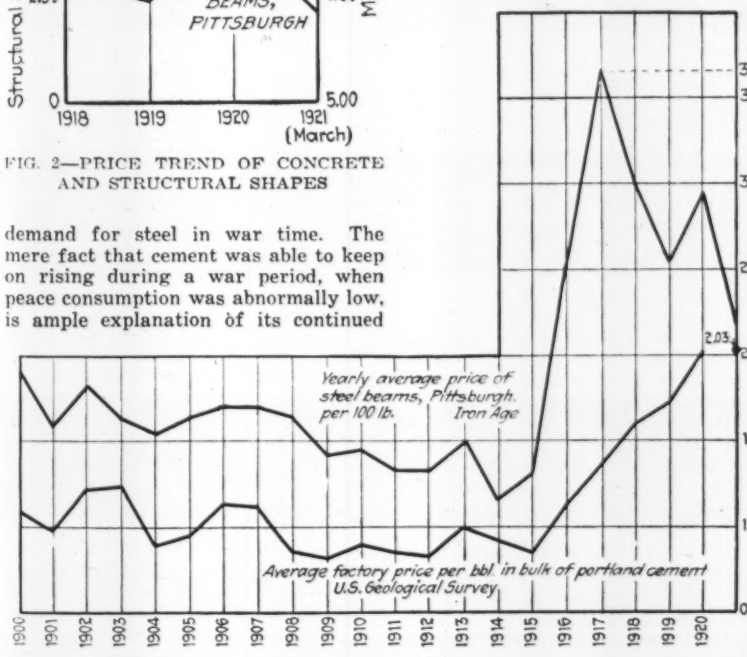


FIG. 1.—COMPARISON MILL PRICES OF CEMENT AND STRUCTURAL SHAPES

The steel prices plotted were taken from the *Iron Age* compilation for 1900-1910, and for 1910-1921 from the files of *Engineering News-Record*. The quotations are for delivery in from one to three months and therefore do not take into consideration the extreme prices paid for prompt shipment. The independent steel manufacturers' price rose from September, 1919, returning to the United States Steel Corporation's schedule in December, 1920, and it is at present below the Corporation's level. The independents received as high as 3@4c. per lb. for bars, 3½@4c. for plates and 3@3½c. for structural shapes.

The following tabulation is of interest as showing the production trend of cement and steel since 1916:

	Portland Cement bbl.	Steel Ingots and Castings, gross tons
1916.....	91,521,198	42,773,680
1917.....	92,814,202	45,060,607
1918.....	71,081,663	44,462,432
1919.....	80,769,378	34,671,232
1920.....	100,302,000	41,000,000

These figures only confirm the expected. As for steel, with the war over and the strike on, 1919 showed a slump of more than 9,000,000 tons. Figures for 1920 are not yet available, but it is estimated that they will be within 2,000,000 tons of the 1916 production.

The case of cement is still more interesting. Despite subnormal construction, 1920 showed an increased production of 9.4 per cent over 1916 and 24 per cent over 1919.

Safe Contract Form Sought

In an effort to make contracts safe the National Association of Purchasing Agents is co-operating with various trade, manufacturing, and professional associations in the United States and Canada. The aim is to arrive at a co-operative contract form which can be standardized, and when universally accepted and established will result in a crystallization of business opinion toward living up to contractual obligations. Each of the national commodity committees will work out a contract meeting with its specific needs, which, in turn, will be presented to the particular trade, manufacturing, or professional organization interested, from whom suggestions and revisions will be secured. If necessary, conferences will be held at which time mutual agreements will be arrived at. When these various commodity contracts are worked out they will be turned over to the standardization committee, which will then draw up a basic standard form of contract meeting the need of every industry. Then, in conjunction with the commodity committee, the standardization committee will make provisions for each special commodity requirement.

Miller Charges Antiquated Port Methods in Plea for Treaty

Governor Miller of New York, at a hearing in Albany, March 15, 1921, on the bill providing a port treaty with New Jersey, charged that the city administration of New York City was in a large measure responsible for a lack of progress in improving antiquated port methods and facilities. His charge was contained in a plea for the passage of the Meyer-Adler New York-New Jersey Port Development Bill.

"To my knowledge," said the Governor, "for at least twenty years the port problem has been an acute problem in the City of New York. You who studied this problem know that the terminal facilities of that port are at least fifty years obsolete, if not more."

The group of organizations favoring the treaty bill, who were present, include: The New York Board of Trade and Transportation, the Merchants Association, the Harlem Board of Commerce, the City Club, the Citizens Union, the Broadway Association, the Fifth Avenue Association, the advisory council of the real estate interests, the Central Mercantile Association and several up-state chambers of commerce.

"While piers have been lengthened," said Governor Miller, "the gentlemen who did that did not stop to think that with the immensely more freight that would have to be handled it would even be necessary to make the piers wider.

"Now, I say that twenty years is certainly long enough to wait before the State could step in."

Constitutionality of Donnelly Law Challenged

Counsel for the members of the Association of Dealers in Building Materials and the Builders' Supply Bureau, New York City, defendants in an indictment charging violation of the Donnelly anti-trust law, have demurred to the indictment and have challenged the constitutionality of the law under which their clients were indicted. It is understood that sustention of the demurrer to the indictment would mean the loss by the state of power to control the monopoly of any commodity. The chief counsel's main contention as to the unconstitutionality of the law was based upon the fact that farmers, dairymen and others were exempted, making the law discriminatory class legislation.

Indianapolis Track Elevation Will Proceed

Doubts as to whether track elevation in Indianapolis would begin this year have been dispelled by advices that the railroads' plans for a crossing over Washington St. at Noble St. will be completed in a few days and will be submitted for city approval. Plans of the Lake Erie & Western R.R. for a freight house at the south end of the track elevation are reported to be under study.

Tax Exemption Bill Stimulates Building in New York

Passage of the tax exemption bill by the Board of Estimate, New York City, Feb. 28, has had marked effect on building in the various boroughs of the city, according to reports emanating from the bureaus of building. Little effect of the bill's passage has been noticed in Manhattan, but in the Bronx in the period between Feb. 28 and March 14 permits were issued for the construction of three tenements, housing 157 families, and costing a total of $675,000, and for forty-eight dwellings, housing sixty-one families, costing a total of $274,250.

During the same period of 1920 permits were issued for the construction of one tenement costing $250,000 and housing fifty-eight families, and twenty-five dwellings, costing $308,000 and housing forty families. This represents a substantial increase in the amount of building undertaken during January and February of this year, permits for two tenements and thirty-five dwellings, capable of housing a total of 153 families and costing a total of $685,700 being issued in the latter month, and permits for one tenement and twenty-seven dwellings for sixty-nine families and costing $276,900 being the record for January, 1921.

In the borough of Brooklyn permits aggregating in value $2,169,117 were issued during the week ending March 12, 1921, as compared with $1,372,705 during the week ending March 5, 1921, and $2,024,470 for the week ending March 13, 1920. Though no total figures are available showing what the effect has been in Queens the assertion is made by those in the bureau of buildings that permit applications for residential building have greatly increased.

Detroit Begins Work on 82 Miles of Street Railway Track

The 1921 construction program of the Detroit municipal street railway was started March 1, with a view to completing an organization and acquiring an equipment to construct the 82 miles of the proposed street railway track at the rate of one mile of track per day. The tracks are to be built and equipped, under the provisions of the ordinance passed April 5, 1920, when a bond issue of $15,000,000 was approved by the voters of Detroit for the purpose of acquiring a municipal street-railway system. Present plans call for the carrying out of the construction program by city forces rather than by contract, with a view to materially lessening the first cost of construction. Joseph S. Goodwin, general manager, is in charge of the work.

Twelve steam shovels have been purchased for excavating for track foundations. Other equipment purchased includes eight clamshell buckets, six 6-ton rollers and four arc welding machines for welding rails. Slag and broken granite aggregate for the concrete track foundation has also been purchased. The city is asking for bids on 11,200 tons of steel rails with all the necessary special work, 40,000 twin steel ties, 100 Peter Witt type double-truck single-end trolley cars, and 25 one-man safety cars similar to those now being operated over the municipal lines. A site is being condemned and plans are being completed for a car barn and repair shop estimated to cost approximately $1,000,000.

$179,000,000 for Canadian Government Railways

A total appropriation for the railways of upward of $179,000,000 is included in the estimates of the Canadian government for the fiscal year ending March 31, 1922, which were presented to Parliament by Sir Henry Drayton, Finance Minister, March 8. Of this amount $165,687,633 is for loans to the Canadian Northern, the Grand Trunk, and the Grand Trunk Pacific, to be secured by mortgages. The deficit of government-operated railroads in 1920 is reported as $49,250,000.

Definite information is lacking as to the exact situation of Grand Trunk financing since the property has not passed entirely into the hands of the government, but it is estimated that some $57,000,000 will be required for current and overdue liabilities, operating deficit, payments for sinking fund and refunding purposes and necessary capital expenditure.

Out of a loan of $50,000,000 to the Canadian Northern provision will be made for betterments, new construction on the Western lines and equipment.

During the year the wage bill was considerably increased by the adoption of the McAdoo award. Hon. Dr. J. D. Reid, Minister of Railways, in discussing the estimates said that the high cost of railway operations, caused by the increased wages, had done a great deal of harm and would ruin the railway development of Canada.

American Exhibit for Peruvian Centennial Exposition

American manufacturers and merchants are to be given an opportunity to exhibit at the Peruvian Centennial to be held this year in Lima, in celebration of the hundreth anniversary of Peruvian independence. For the centennial the Peruvian government has voted approximately $3,000,000. Concessions have been granted to the Peruvian Centennial Exhibits Co., 42 Broadway, New York City, and to A. Smeraldi, Lima, Peru, for the allocation of exhibit space.

More Men Taken on by Steel Concern

Owing to improved conditions in the steel industry the Colorado Fuel and Iron Co., Pueblo, Col., employed 1,000 additional men March 14, press reports indicate. Four idle mills reopened, running two eight-hour shifts.

Railroads and Unions Confer in Wage Dispute

Immediately following the individual actions of most of the large carriers looking to curtailment of forces and reduction in existing wage scales members of the executive committee of the Association of Railway Executives met with officials of the four big railroad brotherhoods in Philadelphia March 14, 1921. Although no announcement was made of the proceedings it was stated that "satisfactory progress was made" in discussing "matters of common interest."

In addition to Thomas DeWitt Cuyler, chairman of the Association of Railway Executives the following members of the association were present: W. W. Atterbury, Pennsylvania Railroad; A. H. Smith, N. Y. Central; C. H. Markham, Illinois Central; E. V. Loomis, Lehigh Valley; A. B. Harrahan, Chesapeake & Ohio, and Hale Holden, Chicago, Burlington & Quincy. The brotherhoods were represented by their presidents.

Wages in Montreal Building Trades Drop Ten Per Cent

At a recent general meeting of the Montreal Builders Exchange a revised schedule of wages to be paid employees in the building industry showed a reduction of 10 per cent. The new schedule is as follows: Unskilled labor, 40c. an hour; carpenters, 65c.; bricklayers, 90c.; plasterers, 75c.; painters, 60c.; cement finishers, 60c.; masons, 60c. to 85c.; stone cutters, 75c., and planer men, 60c. The new wages, except those paid stone cutters and planer men, are now in effect, these two classes to suffer a reduction at the expiration of existing contracts—May 1.

Extensive Road and Paving Work Contemplated

Examination of the construction news of this issue of *Engineering News-Record* indicates that many states, besides those undertaking large programs of improvement, are preparing for spring work. Among the larger builders Ohio will receive bids until April 8 for the construction of 45 miles of various types, upon which the engineer's estimate is for the fifteen projects advertised $1,676,437. New York will open bids March 18 for the construction of about 95 miles of highways, divided among twenty-two projects. As noted elsewhere in this section, Pennsylvania will soon open bids for the construction of close to 90 miles.

Among the smaller states Maryland will receive bids until March 22 for the construction of seven miles, most of the work to be concrete. Tennessee advertises that it will receive bids on about 28 miles of modern-type surfaced roads until April 8. Massachusetts has outlined a comprehensive system of bid receiving whereby available funds—close to $7,000,000—are to be spent on contracts awarded at two- or three-week intervals until mid-September.

In addition to proposed and advertised work, scattering street and highway improvements actually put under contract during the week past total approximately $3,000,000. Miscellaneous building continues more or less active, thirty-eight contracts calling for an expenditure of $5,796,382 having been let.

Africa Asks American Bids

Contracts for grain elevators and equipment for railway electrification are offered in this country by the South African Railways and Harbors, a department of the government of South Africa. Material for the Cape Town-Simonstown suburban line and the Durban-Pietermaritzburg section of the main line includes electric passenger, freight and switching locomotives, electric motor cars and car equipment, substation equipment, transformers, boilers and boiler-house equipment, turbo-alternators and condensing plant. Merz & McLellan, London, England, are the consulting engineers for the electrification, which was noted in *Engineering News-Record* of Jan. 29 and Sept. 16, 1920, pp. 227 and 558, respectively.

The elevator contracts include a terminal elevator of 42,000 tons capacity at Durban, a 32,000-ton terminal elevator at Cape Town, 17 country elevators of 3,000 to 5,800 tons and 17 of 1,800 to 2,600 tons capacity. Bids for elevators will be received until May 2 and for electric plant until May 3 by the High Commissioner of the Union of South Africa, 32 Victoria St., London, England.

Pennsylvania to Open Bids on Ninety Miles of Highways

Until April 1 the state highway department of Pennsylvania will receive bids for the construction of approximately 90 miles of highways. The projects number eighteen, and the prevailing type of construction is to be reinforced concrete, though alternate bids will be received upon considerable hillside brick and bituminous macadam. The longest project advertised is 22 miles in length.

Nevada Commission Against State Making Cement

After an exhaustive study a commission authorized by the 1919 legislature of the state of Nevada has reported to the governor of that state the inadvisability of the state erecting and operating a cement manufacturing plant. The commission found that a liberal estimate of the yearly consumption of cement within the portions of the state that would be available as markets would be in the neighborhood of 60,000 bbl. The basis upon which the report was made was the construction and operation of a plant of 500 bbl. per day, though unit costs were estimated on the basis of 200 and 250 working days per year. Exclusive of the money involved in acquiring a site the commission estimated the first cost in the neighborhood of $400,000 and the sum of fixed charges, operating costs and maintenance an additional $300,000. It advised the governor of the state that using as a basis 100,000 barrels per year produced in 200 days, the unit cost would be $2.565 per barrel. Based upon 125,000 barrels or an operation of 250 days the cost would be reduced to $2.406. The commission gave the opinion that a more logical per barrel cost would be in the neighborhood of $3.25 a barrel.

The members of the commission were H. P. Boardman, chairman, college of engineering, University of Nevada; and J. C. Jones and F. M. Cottrell.

Organized Labor of Boston Enters General Contracting Field

The general contracting field in Boston has been invaded by organized labor, the building trades union construction and housing council being recently chartered. The council is incorporated and assumes the legal responsibilities of a corporation. No paid union official can hold office in the council, which is made up of laborers or mechanics in the construction industry. The corporation is capitalized at $100,000 divided into $10 shares. There are nearly 1,000 subscribers already, and leaders point out the fact that because there are 42,000 union men in the building trades in Boston, more money can be easily raised. Ten shares is the maximum shareholders may buy.

The establishment of a co-operative bank is being considered. Materials will be secured on the co-operative basis, and all material sources which can be financed successfully by the council will be co-operatively developed and operated.

Heavy Motor Crane Combines Mobility and Flexibility

Mobility and flexibility are combined in a comparatively new motor crane designed and built by the International Motor Co., Cleveland. The crane itself follows the usual lines and is the product of designers who have had years of experience in crane and derrick construction. It is of full-swinging, self-contained type, rotating through 360 deg. and is driven by a separate, four-cylinder gasoline motor which is built

DEMOUNTABLE CRANE HAS MANY CONSTRUCTION USES

with an extra large flywheel so as to run smoothly in spite of sudden application and release of loads. The capacity of the crane is 8,000 lb.

The particular advantage of this crane unit is its ability to move rapidly from place to place. This makes it especially adaptable for operations which must be undertaken quickly or for work of short duration.

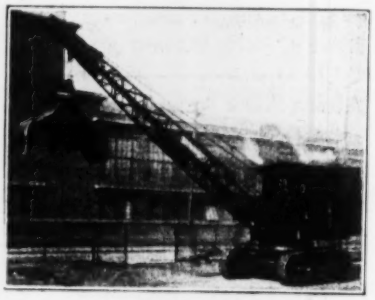
Some of the special uses to which equipment of this type may be put are: Clearing streets of wreckage resulting from fire or collisions; handling trolley rails; and setting up heavy pieces of machinery.

General uses of the crane include setting trolley and telegraph poles, and, fitted with a clamshell, unloading bulk material such as sand, gravel or crushed rock. It is also adaptable to excavating work.

As the entire crane is demountable, the truck chassis may also be used for general transportation purposes.

New Small-Capacity Crane

To fill a need for a small-capacity high-grade crane for use by the general contractor, the Brown Hoisting Machinery Co., Cleveland, Ohio, has developed the Brownhoist No. 2 locomotive crane. The small model is adaptable to a variety of construction uses.



BROWN-HOIST CRANE NO. 2

The machine can be changed in a few minutes' time to handle either a grab bucket, bottom block, or lifting magnet. With these attachments, practically all kinds of material can be handled. All models are self-propelling and when mounted on railroad trucks may be used for switching or loading cars. In order to meet the various working conditions the new cranes are made to operate by steam, electricity or gasoline engine. They are built for use on railroad trucks, traction wheels or creeper trucks, and are built to handle a 1-yd. bucket with loads up to 5 tons, or a 36-in. magnet.

Freight Car Surplus Large

According to an announcement made the middle of February by the car service section of the American Railroad Association a surplus then existed of 358,065 freight cars, this in comparison with an actual shortage of approximately 150,000 cars in the same period of 1920.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Mar. 3.

	New York	Chicago	Atlanta	Minneapolis	Denver	Dallas	San Francisco	Montreal
Steel Products:								
Structural shapes, 100 lb.	$3.58	$3.58	$4.25	$3.86	$5.90	$3.75	$4.70	$5.75
Structural rivets, 100 lb.	5.08	5.08	....	5.50	6.90	8.50	7.05	8.50
Reinforcing bars, ¾ in. and larger, 100 lb.	3.00	3.48	3.75	2.88½	4.37½	3.88	3.75	4.50
Steel pipe, black 2½ to 6 in. lap, discount	39%	53½%	46.65%	46.95%	29@33%	40@45%	36¾@42¾%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.10	64.00	67.80	70.00	66.20	87.65	90.00
Concreting Material:								
Cement without bags, bbl.	3.10	2.17	3.00	2.60	3.10	2.85	3.09	4.28
Gravel, ¾ in., cu.yd.	3.00	2.75	2.62½	2.00	2.50	1.75	2.50	1.50
Sand, cu.yd.	1.25	2.75	1.52½	1.75	1.10	1.75	1.65	1.50
Crushed stone, ¾ in., cu.yd.	2.15	2.75	2.50	2.25	3.50	3.20	2.50	2.10
Lime, finished, hydrated, ton	21.00	20.00	18.00	29.00	32.00	25.00	25.40	32.00
Lime, common, lump, 200 lb. bbl.	3.30	1.65	2.00	2.00	3.20	2.50	2.25	1.60
Miscellaneous:								
Pine, 3x12 to 12x12, 20 ft. and under M ft.	50.00	55.00	37.50	42.00	47.00	45.00	28.00	120.00
Common brick, delivered, 1,000	27.70	15.00	12.50	18.00	16.00	25.00	18.00	18.00
Hollow building tile, 4x12x12, block	not used	12	.14	.10	.10	.21	.12½	.25
Hollow partition tile, 4x12x12, block	.2444	108	.15	...	.10	19½	.14½	...
Linseed oil, raw, 5 bbl lots, gal.	73	85	77	82	97	89	79	1.13
Common labor, union, hour	.75@.80	1.00	.35	.50	.50@.63½	.60@1.00	.81½	...
Common labor, non union, hour	...	.60@.65	.25	.50	.37½@.50	.40@.60	.50@.55	.30@.40

EXPLANATION OF PRICES—**New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the 100-lb. bbl. No organized common labor in Montreal.

Changes Since Last Week

New York dealers report that they are now figuring their profit on brick at 10 per cent instead of at 15 per cent. The present price to users is cost - plus - cartage - plus - 10 per cent, which, with brick at $18 alongside dock, figures $21.70. Hollow tile is still quoted as in the Mar. 3 price section of *Engineering News-Record*. For small quantities of pine delivered on the job the cost is about $80 for 3 x 12 to 12 x 12, 20 ft. and under, the trucking charge being $2.50 per M ft. b.m.

Chicago contractors' associations have offered building trades new agreements effective May 1, reducing skilled labor from $1.25 per hour to $1, common labor from $1 to 90c. Unions have as yet refused to sign. It is reported that the contractors will entertain no other proposition, which means a fight for the open shop unless the unions surrender.

Denver contractors announced a 20 per cent wage reduction for Mar. 17, but the unions have not yet accepted. About 25 per cent of the building trades are reported working.